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May 21, 1921

# ENGINEERING AND MINING JOURNAL

A Weekly Journal of the Mining and Mineral Industries

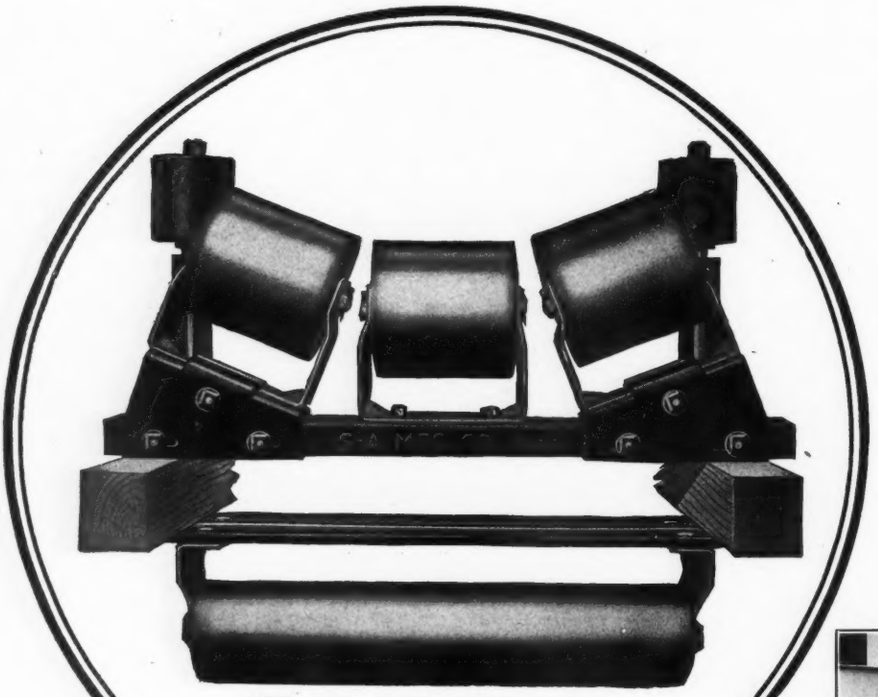
*A Street in Bingham Canyon, Utah—A "Porphyry Copper" Town*

Petroleum in the Canadian Northwest
By Arthur H. Redfield

The Joplin Mining District's Past, Present and Future
By F. Lynwood Garrison

Record Shaft Sinking in Arizona
By E. R. Rice

*Biographical Sketch of* Charles W. Goodale
Mining and Safety Engineer



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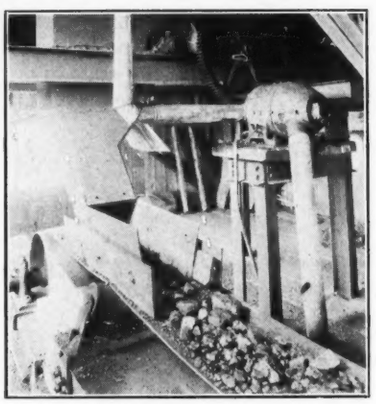

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# Engineering and Mining Journal

*A Weekly Journal of the Mining and Mineral Industries*
METALS NON-METALS PETROLEUM

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## A French-English-American Petroleum Treaty

THREE GREAT NATIONS are actively concerned over their future supplies of that most critical and most unreplaceable of all sources of power, and prosperity—petroleum. They are the United States, England, and France. From a question of prime national importance, the petroleum problem in each of these countries has developed into a matter of international import, and has been the subject for diplomatic negotiations of the first degree of political magnitude. First it was between England and France, during that trying hiatus when our own Government had practically ceased to function, after the failure of the League and Peace Treaty in the Senate. Later, toward the end of the last Administration and continuing with increasing vigor into the present Administration, the Government of the United States, through the State Department, has also been negotiating with England, looking toward a solution of the great problem.

We have no hesitation in calling this petroleum question the most basic, most vital, the most significant and far reaching of all the many problems which the United States is called upon to consider. Here is a type or test case, which, if handled wisely, will be celebrated in future history as being as powerfully activating on all time as was the signing of the compact in the cabin of the Mayflower by the little band of obscure adventurers, or the agreement between the nobles and King John as laid down in Magna Charta. Before the deep import of this opportunity, all other more transitory, even if more noisy, problems take second rank.

The fundamental fact is that the easily and cheaply accessible petroleum resources of the earth are very limited, and within a historically short period the age of petroleum will become a matter of history. But during this age, in which we now live, the possession of adequate petroleum supplies is the master key to growth, prosperity, and commercial power. Airplane, automobile, truck, tractor, tank, submarine, oil-burning navies, oil-burning merchant marine—these and many other key devices depend upon an adequate petroleum supply.

The second truth is that while Nature has distributed her mineral supplies without regard for future population and civilization, the destiny of mankind has become centered in the hands of a few great peoples occupying only a part of this petroleum-bearing earth; and that it is these peoples who use and have most vital need of those supplies which lie in waste or undercivilized places. England, with no petroleum at home, must go abroad, and secure her future supplies wherever she can dicker or deal for them. France must do likewise. The United States, rich in petroleum, has been prodigally producing and using it, and turning it over freehandedly to the world. A true "Coal-oil Johnny" of extravagance, she now perceives the plain handwriting on the wall—plain not only to geologists but to the student of simple statistics, or the observer of statistical curves—that her resources are shrinking with disconcerting rapidity. She too realizes that she must soon adventure abroad, like her great allies, England and France.

These three countries possess ties of sympathy and common purpose whose disturbance would mean a turning backward of the progress of civilization and disaster to the human race. Among them there exist political treaties, the only kind which was realized as necessary in the past twilight of our intelligence. Commercial treaties and agreements, as to the buying and selling of things, have lately become recognized as of more basic importance, although not sufficiently conceded to be so. But the ultimate basis for common understanding, maximum mutual advantage, and world comity lies in agreements on a basis of fact as to the fair distribution of those exhaustible and naturally localized mineral supplies among those people who need them most, and who are fighting the fight of the advancement of civilization. And of these mineral supplies the most critical and important is petroleum. Therefore it is that a carefully worked-out petroleum treaty, a petroleum entente, if you will, based, we repeat, on facts, and, therefore, drawn up not exclusively by diplomats but by men of business and fairness, with the full scientific knowledge of the occurrence and distribution of petroleum so lately attained—such a petroleum agreement entered into by England, France, and the United States would insure the world's peace and unity more than would the League of Nations, the International Court of Justice, Mr. Wells' World State, or all the longings of the socialists and pacifists, communists, and the rest of the impractical dreamers.

We hail the dawn of a new era, when fact and science shall be the basis for national laws and international agreements, instead of the past ignorant makeshifts of uninformed politicians and so-called diplomats, and tugs-of-war between interested but stupid parties. Such an era may well be ushered in by honest conferences of the three great friendly countries on the key problem of the allocation of petroleum supplies, not only for themselves, but, with a joint stewardship of the petroleum treasure houses, for the world; and the formation of a petroleum alliance, to which should be admitted guardedly other nations, as the situation justified, and as they signified their desire.

To quote Cleveland's oft-repeated but immortal phrase, it is a condition which confronts us—not a theory. It is either, from now on, agreement as to a fair rationing of basic world resources among great and ambitious peoples, or that fierce competition whose normal climax is war. With such agreements, the problem of reducing navies and armies becomes no longer a dream, to which

we subscribe while voting for enormous increases, but a natural consequence into which we would slip without argument. The vast waste of war and the preparation for war would be applied to betterments, instead of plans for destruction, with all the undreamed-of progress of humanity that would result.

We wonder if the actors in this most historic world drama—those dealing with the petroleum problem—in England and France, and the United States—realize the gigantic rôle they are playing in the world's history, and how the episode may be taught to wondering school children a thousand years from now. We hope and believe that they realize the magnitude of the responsibility that is theirs.

Let not such an agreement be hastily made, but, by considering the full basis of fact, be rendered sound and fool-proof. Here there is work for special commissions, to be appointed from each of the three countries, each to be composed mostly of those who know, and not so much those who only dicker; and for common meetings and conferences of these three commissions (which thus would constitute an official French-English-American petroleum conference) until the best solution shall be attained, and submitted for ratification to the respective governments.

## Tax Exemptions And National Income

A BILL has been introduced in the Senate by Senator Pittman providing for the exemption from Federal taxation of the net income derived from the mining of gold, or from the mining, milling, or reduction of silver. We cite the above accurately: the specific differences in exemptions of the two metals is as stated; and if the bill should be likely to become a law, a more careful phraseology would become necessary to establish what, considering the context, is very uncertain, namely, the exact field covered by the term "mining of gold," as it evidently does not include milling and reduction, specifically referred to in the case of silver.

We do not think, however, that there is any likelihood of the bill becoming a law; and no doubt it was introduced to call attention to the present inequalities and vagaries of our existing Federal tax laws. We are passing through a state of cumbersome experimenting in taxation. It has been sought to raise the enormous revenues needed for war, extravagance, and inefficiency by heavy taxes on incomes and on excess profits. These methods were, of course, popular, and such a plan was bound to be permanently in favor. The taxation of the few to support the whole is always sure of the vote of the majority, who thereby secure total exemption for themselves. The only trouble was that it did not work.

The excess-profits tax shows a startlingly dwindling return; for the net result of it is that in an increasing number of cases "there ain't goin' to be no core" in the shape of excess profits for the Government. Lack of stimulation for business enterprise, and the devising of methods to avoid excess profits, naturally resulted from this excessive form of special taxation; and the same applies to large incomes which are the result of individual earnings and enterprise. As for the really statically wealthy, whether individuals or corporations, a pre-existing hole in the law made it possible for them to become exempt—we refer, of course, to the total exemption from taxation of the bonds of states or any subdivision thereof. The great amount of such bonds in circulation has been enormously stimulated by this exemption, and a flood of state, city, town, village, school district, highway improvement, waterworks, drainage district and other tax-free bonds has been poured forth in an increasing stream. It does not pay the wealthy man and the statically wealthy corporation to invest their surplus in anything but these securities: the difference in net yield is so great as to leave no choice.

An expert, representing the public utilities corporations, testifying before a committee of Congress the other day, estimated that for incomes of more than $10,000 it did not pay to buy anything but tax-exempt securities. Expert advisers to investors take this element into consideration in suggesting what bonds to buy and what not. The result is that the very class of the rich who were the target of the unmoneyed majority who framed the scheme do not contribute; naturally the tax does not fall on the poor; and again it is Mr. Average Citizen who digs up. Unless this tremendous exemption is removed, the income tax will continue to be the national economic joke that it is at present. Therefore, Secretary Mellon has advised a constitutional amendment removing this exemption; and a bill for that purpose has been introduced by Congressman McFadden. But a constitutional amendment, requiring the consent of three-fourths of the states, takes a long time to pass; and probably many states will not agree to give up so shining a financial advantage.

And what in the mean time? How shall the money for government demands be raised, and how shall the taxation inequities and the resultant business distress be removed? Because the big investor puts his money into state and municipal bonds, he does not put it into railroads, public utilities, and other forms of private business in which the public has the main interest. The result is that these enterprises, of national significance to all of us, cannot secure funds, except in small amount and at a very high cost, from the small investor. Therefore, extensions cannot be planned: charges for service must remain high to cover costs; and both a healthy growth of vital enterprises and the process of deflation and return to "normalcy" are indefinitely postponed.

One result of the situation, pointed out by the public utility experts, is the tendency to deflect thought into the direction of public ownership of public utilities. We do not say of railroads, for the public stomach has had enough of that particular brand for the present. But why should the citizen stand the high charges and inadequate service (due to the difficulty and cost of getting funds) of privately managed corporations, when by throwing such corporations into municipal control they could be abundantly financed tax free? Therefore, there is an artificial stimulus to the trend toward state socialism which most thinking men want to tread reluctantly and cautiously, if at all.

The most immediate remedy, say the privately controlled public-utility experts, would be tax exemption on their securities, so as to give them equality with municipally controlled public-utility securities. The same remedy occurs to others: for the gold and silver mining industries, as instanced in Senator Pittman's bill, for example. Should the production of the sound basis for money be taxed, in a period of paper inflation? Certainly not. Home owners insist also that real-estate mortgages should be exempt. Should the struggle to found a home be taxed? Assuredly not: a national

premium should be put on this. The farmers also claim that their net income should be exempt. Should the enterprise of those who grow food for the nation be dampened? Of course not: the trend back to the farm would make us all better off, and should be stimulated as a national policy. So when we are through with our just exemptions, we shall be collecting only from those poor goats who are slow to holler, if we may use the figure.

The point is to have no exemptions; to remove at once the tax-free exemption feature of state and municipal bonds. If this cannot be done, the income tax is a monstrosity and a failure, and had better be abandoned at once in favor of something equitable and workable.

## The Journal's Shaft-Sinking Medal

ABOUT A YEAR AGO—in our issue of May 15, 1920, to be exact—we announced the offer of a gold medal to be presented to the crew breaking the world's record in shaft sinking. In a subsequent issue—that of Aug. 21—we published the rules drawn up by the committee appointed to judge the records submitted, but since that time—through no fault of the committee, however—their work, as such, has been at a standstill. At first we were inclined to think that a lack of reports from the committee as to possible aspirants for the honor might indicate that there was inactivity in the shaft-sinking business, but a general review of the news from the various districts during the last year shows that almost a normal amount of that sort of work has been done. It may be assumed that the rules as set down by the committee are regarded as satisfactory, for there has been no criticism of them by our readers.

A year having passed since our original announcement, it seems a particularly auspicious time to again mention the matter of the gold medal. It will remind the industry that we have not forgotten our offer and that we still have faith that the record will be broken.

It will be recalled that the *Journal's* announcement of the offer was made directly following the report by the Van Dyke Copper Co., of Miami, Ariz., that it had beaten the world's record of 279 ft. in thirty-one days, then held by the Crown Mines, Ltd., of Johannesburg. It subsequently developed that a record of 310 ft. in thirty-one days had been made during July, 1919, by the Crown Mines, Ltd., but had not been announced in this country. However, as far as we can learn, the Van Dyke Copper Co. holds the palm in the United States, having sunk its No. 1 shaft 308 ft. in thirty-one days. A description of the manner in which this was accomplished appears in this issue, and contains many details that will be of value to those engaging in similar work.

It must be conceded that the conditions under which the work was performed at the Van Dyke shaft were exceptionally propitious and that the progress made was due largely to certain favorable features that would not be met in most mining districts. Yet there were drawbacks, such as the comparatively small cross-section area of the shaft, and sloughing and variable ground. Although there will be those who will dispute the claim of the record under the circumstances given, we are of the opinion that the claim is fairly made, and is not intended to include more than the record for linear footage. As such, and considering the performance of many details, the work was well done and with dispatch.

With the knowledge of conditions under which the footage at the Van Dyke shaft was made and the circumstances surrounding the sinking of other shafts, it would seem that the opinion expressed by the Medal Committee in stating the rules which are to govern the award was not without justification. This was as follows, and appears in the Aug. 21, 1920, issue of *Engineering and Mining Journal:* "It will be appreciated that any attempt to specify conditions as to cross-section area or shape of shaft, hardness of ground, number of men employed, or any other condition which would have bearing on the progress made in shaft sinking, would introduce complications in the judging of the contest, and such complications would undoubtedly prove to be a source of discussion and difference of opinion, to say nothing of probable dissatisfaction on the part of the contestants with the final decision of the judges. In the formulation of the rules, the question of specifying weighted values to certain conditions and making the award on the greatest number of points seemed to have possibilities, but, after due consideration, it was deemed best to hold strictly to the first announcement in its simplest interpretation, i.e., that the medal be awarded to the crew breaking the record in footage within the time limit specified."

## The New Mine Tax Law Of New Mexico

THE COMING YEAR will witness the first attempt in the Rocky Mountain section to impose state and local taxes upon a valuation of mines determined on the basis of the engineer's valuation. After a long and violent controversy, the Legislature of the State of New Mexico, at its session just ended, made provision for an appraisal of the mines of the state by a professional engineer. This method, which has commended itself to many by its record in Michigan, Wisconsin, and Minnesota, will now be given a trial among the coal and copper mines of the West.

The law, as passed, does not require the state tax commission to accept the engineer's valuation as the assessed value of the mines. In fact, the act specifically states that the commission may adopt the basis of net output as a more satisfactory measure of the value of the properties if it so chooses. But the physical valuation is to be made and the results are to be a public record. If the appraisal reveals any considerable divergence from the values arrived at by the net-produced method, the state of public opinion in New Mexico will in all probability insure its adoption by the commission as the basis for the levy of the taxes.

The new law was passed over the protests of some of the most important mining interests of the state, the companies owning large reserves which have been covered by a "contiguous property clause" in the old law being especially active in their opposition. This clause, which existed in a very extreme form in New Mexico, is now eliminated, and the commission is given general power to determine "reasonable" reserves. The appraisal is limited to operating mines.

The action of New Mexico is in line with recent developments in this field. It comes as the direct result of the activity of a Special Revenue Commission established by the Legislature a year ago, headed by Ex-Governor Herbert J. Hagerman, and accords with the recommendations of the special committee of the National Tax Association which reported on this problem last fall. The results of the experiment will be followed with great interest by all who are concerned with mining in the Western states.

# WHAT OTHERS THINK

## The Problem of Mining Canadian Iron Ores

An article under the above heading appeared in *Engineering and Mining Journal* of April 16. In this the question was discussed: "That if the Federal or Provincial government would grant a bonus of $1 per ton of ore mined, it would give an impetus to the starting of a Canadian iron-mining industry; or, instead, if these governments would set aside a sum of $300,000 for experimenting with the low-grade magnetic iron ores, contaminated with silica, phosphorus and sulphur, of which there existed large quantities in this country, a process might be found to utilize them in the furnaces."

If the advocates of such measures would have informed themselves more accurately on this subject their assertions would not be misleading, and, consequently, no harm would have been done to either individuals or the whole country and its natural resources.

Bonusing industries is still considered by many a panacea for attracting them. This is, in my opinion, however, a doubtful stratagem of political economy; if an industry cannot stand on its own feet, it is not worth having. When I hear of concerns asking or being offered money or building sites from communities, or asking financial or legislative support from governments, I feel always as if those who ask or are offered such favors give themselves a *testimonium paupertatis*, intellectually, technically, and practically, and communities or governments that are supporting these enterprises experience frequently just the contrary of what they were expecting from them, owing to conditions that were produced, to a lack of initiative and energy in the managing of the business.

Moreover, can the governments at the present time of universal need and tightness of money afford to support industries financially? And even if they could scrape a few hundred thousand dollars together, what benefit would it be to the iron miners throughout the country, when we consider that these ores are treated only in plants of large capacity? Let us suppose we have four such plants, each concentrating one million tons a year. How much would the governments have to set aside to pay $1 per ton mined? Could they do it? Would it be fair to the other industries? But is it, indeed, necessary that an iron industry should be coddled in that fashion in this country? Are our iron deposits of such nature that they need governments' help and experts' knowledge to bring them into use? No, they are not; they possess every possible advantage; they are of immense size—so much so that we could supply the world for centuries; they do not contain elements that could not be easily eliminated; they will produce a high-grade bessemer product.

Through a considerable stretch of country the railways run right through and past these deposits, and Lake Superior is reached at short distances. Water in rivers and lakes skirts the land, and wood for every purpose is locally available in considerable quantities.

The average grade of ore is about 37 per cent iron, the concentrates or briquets run 66 to 68 per cent; phosphorus, 0.008 to 0.012 per cent, and sulphur practically nil.

We hear also from them that we have to apply to each little different grade of these magnetites costly experiments to find the right process, whereas in fact almost every existing plant uses the same method to beneficiate these ores.

If we go into the Arctic Circle north of Norway, or go to Sweden, or the eastern United States or the northeastern Mesabi, all use practically the same process, and many of these plants operate on an ore similar in type to that which we have in nearly 250 miles of deposits.

I have made many concentrating tests with a number of ores coming from Canada, but never found any difficulty in producing that which I wished or expected to find. Why, then, should it be necessary to ask the governments to vote a sum of money for experimental work? Of course if an engineer has a certain predilection for his own ideas, it is his business to determine how much he will spend to make them fit his case.

There should be no difficulty in convincing those interested in the iron industry that the beneficiation of the low-grade magnetites contained in immense deposits situated in many parts of the world is, I may venture to say, almost an economic necessity for many nations, the United States included, and they should begin to uilize them in the iron industry now. Whatever knowledge or experience that we may need in the handling, producing, and utilization in the furnaces at the present moment is a gaining of time and expenditure when we are forced to use them. We have sufficient examples and patterns to work by. We have no excuse to be over-conservative or too timid in face of what many still call a new, untried thing. Such an attitude may be expected in those who stand frigidly off toward other people's or other nations' mode of working, inventions, processes, or methods, but this does not indicate progress.

F. HILLE.

Port Arthur, Ont.

## The Mining Engineering Standard

It is a genuine pleasure to read such a clear-cut, outspoken editorial as that contained in *Engineering and Mining Journal* of March 26, entitled "The Mining Engineering Standard." Strange as it may seem, there is no topic which calls forth more nonsense than a discussion of mining education.

If mining engineering is a profession, and not a business, a trade, or a calling, there must be some definite and prescribed course and training required from those whose purpose it is to follow it. Among the best mining schools of the country it has long been recognized that there were certain basic sciences which were necessary.

It has often been urged by the thoughtless that because there were certain branches in the standard mining course, which were not in daily use by the practitioner, they should be eliminated. The greatest stumbling block to the shiftless and incompetent student are what may be termed the mathematical sciences, including pure mathematics, mechanics, and physics. Remove these subjects from the engineering courses, and almost any person can pass with ease; and it is these very subjects which the self-trained candidate for honors as a professional engineer knows the least about and for which he has the highest contempt.

The tendency in almost all the second- and third-rate mining schools has been to disparage the work done in the really fundamental and valuable basic sciences, and place the emphasis upon the practical stuff. To one who has been through the mill, this is not difficult to understand. With modern educational theories, which are much in vogue, it is held that the young and inexperienced student knows best what courses are necessary for his professional training; and by giving him what he thinks he wants instead of what he ought to have, one source of complaint is immediately eliminated.

As an example of how crude and poorly trained some of these graduates can be, years after leaving school, and engaged in practical work all the time, I have culled two gems from a report made by one of these men not long ago upon a copper mine belonging to one of the large copper-mining companies of the Southwest:

Under the pompous title: "General Theory of Contact Metamorphic Ore Deposits," he goes on to say:

> In the case of water heavily charged with its load of minerals, and ascending through a permeable porphyry the load may be gradually kicked out of solution as the heat and pressure are reduced, and this often takes place with no evidence of chemical action, hence a "Disseminated porphyry."

Again, under another chapter, bearing the title "General Theory of Ore Deposits Applied to ——— Limestones" he says:

> We may properly think of the two walls of a fissure as leaning against each other, and leaning with considerable weight. In case of firm rocks the impingement is greater at certain lines along the fissure. In some fissures these lines of great impingement are no more than 25 ft. apart. In others they are as much as 100 ft. apart. The ascending solutions follow the lines of least resistance. Where there is a line of great impingement the solutions will pass at one side. In case of mineralization along this fissure we would not expect the mineralization to include this strip where the impingement is very great.

I am sure that all those interested in the "Disseminated Porphyry" copper mines will be grateful for this valuable hint which this author let drop as to their correct genesis. It is unfortunate that in assuring us that "Where there is a line of great impingement the solutions will pass at one side," he did not enlighten us as to which side. But exactly what an "impingement" may be, still remains a deep, dark mystery.

It is just this kind of stuff which is inflicted upon a guileless and unsuspecting public by men of this stamp that would in large measure be eliminated if men who are in every sense of the term professional engineers would see to it that the preliminary training received in college is set and maintained at a high standard, and that a few months spent in skimming over the elementary books of some correspondence course during idle hours is not sufficient preparation to admit the candidate into the profession of mining engineer.

Mineral de El Oro, Mexico. ROYAL P. JARVIS.

## The Licensing of Mining Engineers

May I call your attention to a lapsus linguae in your editorial "The Licensing of Mining Engineers" in *Engineering and Mining Journal* of May 7? The editorial says, "In New York State at present there is a movement to take away the privilege of corporations to secure a license . . ." The licensing of corporations as such has never been a question in point. The matter to which you refer is covered by a clause in the bill which reads, "Nothing herein shall apply to a corporation, partnership, or joint stock association, provided the person or persons carrying on the actual practice of engineering on behalf of such corporation, partnership, or joint stock association shall be licensed engineers." This is the crux of the dispute being fostered by the consulting engineers of New York who want to prevent any corporation from practicing engineering which has any corporate member who is not a licensed engineer.

The fact that the Governor has signed the bill against which they were protesting might seem to have settled the matter in this state. Not so, however; because the consulting engineers have given notice that they will take the matter up with the Licensing Committee of the Federated American Engineering Societies and endeavor to have Engineering Council's Model Bill, which contains a clause similar to that quoted above, amended by eliminating this clause.

The mining engineers have been rather derelict in giving the particular question of licensing engineers the attention which it deserves. Now that the New York law is on the books, and every consulting mining engineer in New York must within the next twelve months take out a license in order to continue practicing, our mining engineers are beginning to ask themselves in how many states they must take out licenses.

The registration fee in New York is $25, and if you want to do land surveying on which titles and conveyances depend the fee is $35. Fees in other states are similar. Therefore, a consulting mining engineer in New York City, in order to be prepared for the practice of his profession at any time in the West without inconvenience and delay, should consider licensing himself in advance in each state where he is likely to want to practice. Multiply this number of states by $35 and he will have an idea of what it will cost him the first year. There will be renewal fees in many states.

It seems to me the matter of licensing engineers is more serious for the mining engineer than for any other type. I see no objection to a civil engineer, whose practice is more or less confined to one locality, like that of a doctor or a lawyer, having a license, or an electrical engineer, or a mechanical engineer, who, connected with large manufacturing operations, is fixed for long periods of time in one city. The mining engineer, with his nomadic existence, bears a hardship under licensing which is not borne by any other of the professions. I am informed that in one state only civil engineers are licensed and civil engineers are defined as all engineers except mining, metallurgical, and military engineers.

The mining engineers of Nevada temporarily killed the licensing bill there, the Boston engineers did the same for Massachusetts, and the engineers of southern California killed one effort in that state. The mining engineer might well devote some of the time which is not now required in producing metals to thought and expression on this topic, which so vitally affects him.

New York. PERCY E. BARBOUR.

# The Joplin Mining District's Past, Present and Future

## Although Ideally Situated, a Survey of Existing Depressed Conditions Shows That Efficient Development of Mines Has Been Hampered by Geological and Industrial Factors — Increasing the Tariff May Encourage Current Wasteful Methods

BY F. LYNWOOD GARRISON
Written for *Engineering and Mining Journal*

CONSIDERATION of conditions in the Joplin district presents some phases of industrial disorder deserving of the most careful study by the mining economist, be he engineer or operator. I recently spent several months in the Joplin, Mo., district, and had an exceptional opportunity to obtain an insight into the prevailing status of the mining industry there. It is the purpose of this paper to review the situation briefly, endeavoring to point out the origin of some of the fundamental forces that have given rise to these unprecedented conditions and also to indicate their growth and their inevitable results.

The Joplin mining district is that large lead- and zinc-producing region situated in the southwestern part of Jasper County, Mo., the southeastern corner of Cherokee County, Kan., and part of the northeastern corner of Ottawa County, Okla. In Newton County, Mo., there are several small detached camps, such as Granby and Spring City, of relatively small importance. The boundaries of this mineral-bearing domain are as yet undefined and probably are undeterminable. At the present time it is more than likely that the prospected and developed region constitutes but a small proportion of the whole area.

The mines clustered in and about the city of Joplin are supposedly exhausted, or nearly so, and have ceased to produce any considerable proportion of the whole output of the district. As a rule they were never as rich as the newer deposits in the Kansas-Oklahoma field. The assumption, however, that the Joplin mines are worked out is not, in my opinion, justified, difficult or impossible as it is at present, and probably as it may be for years to come, for them to compete successfully with richer discoveries further afield.

The mineralization of this great area is a matter of supreme interest, and should be of the first importance to the operator. It is, however, a highly technical subject, not yet wholly understood, although it has been intensively studied by geologists and mining engineers for the last fifty years.[1] Clearly to present the subject of this paper, general conclusions concerning the ore deposition may be briefly sketched.

### SPOTTY OCCURRENCE OF DEPOSITS

The ores occur irregularly in sedimentary rocks having a slight westerly dip. The orebodies do not outcrop, although they are invariably near the surface, occurring from 50 to 150 ft. in depth in the eastern part of the field and from the 150 to 350 ft. in the Picher and Baxter districts. There are no surface indications of their presence, and they must be located, hit or miss, by drill holes or shafts. They may be likened to the raisins in a pudding or cake, whose presence beneath the crust is taken for granted. The limit of the pudding is that of the area of the particular rocks in which the ore occurs, and never elsewhere; but, of course, many parts of the pudding may contain no raisins, although the possibility always exists.

As the result of many years of prospecting and mining, certain almost unvarying characteristics of the orebodies have become clearly established. Thus the orebodies appear to possess a general trend or linear extension to the west and southwest, although this rule is not invariable, a peculiarity accounted for by Siebenthal[2] by their deposition in the channels of a former underground drainage through limestones of the Boone formation. This artesian hypothesis has been so well sustained by recent developments in the Oklahoma field, that little reason remains to question its soundness. Another characteristic is the intimate association of the ore with the black shales of the Mississippian rocks of the Lower Carboniferous, shales which are locally known as "soapstone," and form an impervious cover to the limestones. Undoubtedly the carbon and hydrocarbons of this formation were an important factor in the deposition of the ores.

In the Picher field the shale covers the deposits in an almost continuous sheet, preventing the underground mineral-bearing solutions from reaching the surface. Whether these solutions came to the surface in the more eastern fields at Joplin and Webb City, where the hydrostatic pressure was doubtless less, we have no means of knowing. We do know, however, that the shales are here much more patchy or spotty in their occurrence and frequently disrupted by local faulting and consequently could offer much less resistance to an upward flow. On the whole it would seem that the question of local faulting has not been given sufficient consideration by the geologists who have studied the subject.

### TEMPORARY AND INDEPENDENT CHARACTER OF OPERATIONS

The ore deposition of the entire Joplin region is unquestionably discontinuous or at best loosely grouped and scattered over a large area. In consequence, the development has been spotty, each mine and mill, a small affair as metal mines go, being a separate unit or organization in itself, with a resulting duplication of overhead costs. In the course of years this system has been improved by the grouping of two or more mines under one management. No great mines and mills designed to operate on one plan over a long term of years exist in the district, the estimated life of any one deposit not being considered sufficiently great to

[1]The Schmidt and Broadhead report was printed in 1874 and contains some excellent sketches of underground structures as developed in those early days at the mines of Joplin, Oronogo (Minersville), and Granby. It is a valuable publication, and now probably scarce.

[2]Bull. 606, U. S. Geological Survey. This publication is about the last word on the subject and is one of the best treatises that have appeared. Though the author has drawn freely from previous publications, he sticks consistently to his own thesis, which appeals to the technical reader familiar with the subject as sound and logical.

warrant the expensive equipment which the refinements of modern mining and milling would require.

The fact that the lead and zinc deposits are so near the surface, and are scattered in spots over such a large area of flat prairie land, well provided with transportation, and certain other favorable living and economic conditions, combine to make the Joplin district pre-eminently a poor man's mining country. A few hundred dollars will suffice to drill some shallow holes, and a few thousand to provide a shaft from which to hoist ore, once it has been found in promising quantities.

An old type of mill cost four or five thousand dollars, and a lease on a 10 per cent royalty could be easily picked up for little or nothing; consequently, a Joplin miner or a group of miners could easily begin in a small way and often lay the foundations of a fortune. An even simpler beginning might be had with a horse-whim and a hand jig. As a poor man's country, Joplin is unrivaled, and may it long so continue!

The district, however, has had several booms, and it is questionable if on the whole they have been beneficial for the industry. Its fame for cheap opportunity was proclaimed world wide, with the result that all sorts and conditions of mankind floated in, only to drift out again after experiencing disaster in attempting a mining game that looked easy but which is actually hazardous to the ill-equipped in funds and practical experience. It is truly a poor man's camp only to those thoroughly familiar with the peculiarities of the district.

The present business depression is proving a terrible experience for the small operators, and unless a decided change for the better soon takes place many of them will be bankrupt. The basic conditions of the whole industry are unsound, unelastic, and must be changed if the district is once again to prosper and not cease to be a poor man's opportunity.

### Leasing System Subject to Numerous Evils

Probably the most serious of the fundamentally bad conditions are some of the common practices of the leasing system. In the Joplin region the land owner is seldom an operator, although land is cheap and there is plenty of it. In the "good old days" of twenty-five or thirty years ago, the usual practice was to lease blocks of forty, eighty, and one hundred and sixty acres, to operators for periods of ten to twenty years at a 10 per cent royalty. That is, the operator paid the land owner 10 per cent of the market price of the lead and zinc concentrates which he sold, usually at the end of each week. The settlements being made in cash through the bank, were a good remuneration for the land owners and not hard on the tenant as long as the mine continued to be fairly productive.

Previous to the boom of 1897 such leases could often be had for the asking, which brought in its train a horde of speculators and established the practice of buying and selling leases, as in the oil business. Ridiculous prices were paid for leases, which at best are always a dubious asset, unless for a long term; royalties were pyramided up to 25 and even 30 per cent, and almost every outsider who came into the district during the boom days departed a poorer, if not wiser, man. Such experiences are not conducive to the good name of the place or its inhabitants, and were repeated in an even more accentuated form during the recent boom of 1915-1918, when ore prices reached the highest ever known, a condition complicated by the fact that the event was practically coincident with the discovery and development of the Oklahoma field, where nearly all the land is owned by Indians.

When the Government gave these lands to the Indians is was supposedly for agricultural homestead purposes, and the mineral contained therein was probably not considered. It cannot be said that the huge sums the Indians are now getting from royalties is to their best interests morally or in the end materially, and the uncertainties and complications involved in the mining leases granted on these lands are not conducive to the sound, healthy development of the white man's business. Much confusion and uncertainty as to title would be removed were the Government to establish a uniform, liberal policy in regard to the leasing system, especially were royalties never in excess of 10 per cent and the life of leases not less than twenty years, which leases should also contain a prohibition forbidding any increase in the royalty when or if transferred or sold.

### Royalty Above 10 Per Cent Not Warranted

The average operator cannot afford a royalty above 10 per cent. He might be able to pay 25 in war times, when zinc concentrate brings $100 or more per ton, but under normal conditions the richest mines in the Oklahoma field cannot make their zinc concentrate for less than $16 to $20 per ton, and then only for short periods when the richest ore is being mined. Taking the Joplin district as a whole, it has been estimated that under the recent cost for labor and supplies, the average cost per ton of ore hoisted into the mill is about $2.40. The average tonnage of concentrate is 6 per cent of the weight of ore milled; hence $40 is the cost per ton of 60 per cent concentrate in the bin. The royalty is not included, as that is deducted from the selling price when the ore is shipped from the mill to the smelter, whereby the land owner parts with his interest in the product. The land owner is always sure of his royalty, whether the operator makes or loses on his output.

One of the results of this Government policy, or the lack of it, has been to stimulate development on non-Indian lands, especially those in Kansas immediately west of Baxter, where, geologically, conditions are precisely like those in the Picher field. In fact, it is all one area in a geologic sense. The prospecting operations now going on in this district appear to be in strong hands and to be getting good results. The drift of development is undoubtedly across the state line north and northwest from Oklahoma into Kansas, which will have the effect of making Baxter the most important mining and business center of the whole region, because it has excellent railroad connections and is an old, well-established town.

Twenty years ago it was generally believed that no ore would ever be found west of Baxter Springs. The discoveries along Tar Creek, in Oklahoma, just south of the Kansas state line, began the development in the Picher field, closely followed, if not contemporaneous with, the ore strikes at Commerce, just north of the little cow town of Miami, Ottawa County, Okla. The boom of 1917-1918 made this squalid settlement on the banks of the Neosho River one of the most modern, attractive little cities in the Middle West. We earnestly hope it will survive the present crisis, even though the drift of the mining development is trending more and more toward the north.

In writing about this interesting region, its mines, and its men, it is pleasant to be able to record the unusually cordial and mutually helpful relations between operators and employees. Strikes are unknown, no labor unions exist in the district, and the miners are almost wholly native-born Americans, mostly boys reared on neighboring farms. Negroes are conspicuous by their absence, and are not wanted in any capacity. Many of the operators and practically all the superintendents were once just common miners, who raised themselves step by step, as an intelligent native American will do when given the opportunity, freed from the trammels of restrictive unionism and the poison of specious propaganda.

The operators deserve great credit for the way they have combined to build good roads and hospitals, and especially for the considerate treatment of their men in the present industrial depression. During the last winter not a few mines were operated at an actual loss so as to keep the men from distress, and the miners in turn intelligently and willingly agreed to a considerable reduction in wages, for there was little difficulty in making them understand the situation and the need for co-operation and essential concessions in remuneration.

A dreadful disease due to the character of the rock in which the ores occur, known as miner's phthisis, or consumption, and which has been the cause of so much trouble in the Transvaal gold mines, is not uncommon in the Joplin district. The finely powdered siliceous dust, composed of sharp angular microscopic fragments of flint, enters the lungs and cannot be thrown off, resulting in time in tuberculosis. Here, as in South Africa, preventive measures have been taken, and the trouble has been minimized as much as possible, but sad cases are often found which are beyond cure. In such instances the operators and the men themselves have been most sympathetic and helpful to unfortunate victims. It is to be hoped that a well-founded sanatorium will be established ere long for the care of these miners. The men who have made fortunes in this district ought to bear this in mind, and doubtless will do so when they realize the need. Sanitary conditions and the comfort of the men cannot be expected to be as complete and efficient at the small plants common in the district as they are at great mines whose life in one spot may cover many years. The little mines and mills are here today and gone tomorrow. Tearing down and rebuilding the same mill miles away is a common practice in the Joplin district.

### Improvements in Marketing and Financing Desirable

The great danger of the present crisis lies in the fact that so many of these mining companies are overcapitalized and have no financial resilience. They paid large prices for their leases during boom days, the royalties are now excessive, and the whole district suffers enormously from a lack of common-sense economies which sooner or later must be adopted if a large number of the operators are not to become bankrupt. A system of common selling of their product, thus eliminating the pestiferous "ore buyer"; a combined agency for the purchase of supplies, and the elimination of the elusive and peripatetic "powder agent" are among the reforms most urgently required. Nor are the operators unaware of the need for these reforms. The difficulty has been to obtain co-operative action sufficiently strong to overcome the inertia of established custom and the subtle influences of personal friendships and obligations.

Upon questions of operation and technical practice a visiting engineer, even though he be a former Joplin operator like the writer, does not willingly offer gratuitous criticism. He knows from experience the difficulties of the situation; he is more sympathetic than censorious, being fully aware of the fact that there are engineers in the district more competent than he is to suggest improvements wherever conditions may seem to warrant or justify them.

At first sight, nearly all the engineering practices in the district seem and are crude. After a better acquaintance with conditions, a reason for these seemingly slipshod methods is evident. The question is, are they not carried too far? Are not the wastes and extravagances of which everybody is conscious the result of the unsound, fundamental defects that I mentioned in the beginning of this paper? Would not larger and financially stronger companies, provided with competent engineering staffs, eliminate these wastes? Undoubtedly they would, but the poor man and his little mine could not compete, and his eventual elimination might follow, which, in my opinion, would be a calamity.

### Joplin District Advantageously Situated

In quality and in quantity the Joplin zinc ores are without a world rival. As placed on the market, the concentrate averages a metallic content of 60 per cent zinc, little iron, and a large amount of sulphur, usually wasted by the smelters, to the annoyance of their neighbors and the satisfaction which some corporations seem to enjoy in squandering the gifts of a bountiful Nature.

The demand for these rich ores to "sweeten" the leaner grades of other localities ought to be, and probably is, large. European smelters are keen to have them, but were unable to import them in pre-war days, for various reasons which cannot now be discussed. At the present time their need is even greater, but the differential in exchange forbids importation. Hence with the domestic zinc market shot to pieces, the poor operator holds the bag while interest charges and natural deterioration of plant eat him up.

It seems useless to delude ourselves with the hope that the condition of the zinc industry will materially improve in the near future unless something is done to assist it. Whether anything can be accomplished with that end in view is an important question. The usual nostrum suggesting itself to the political economist in such cases is the tariff pill: that wonderful panacea for all the economic evils which afflict a hermit country sufficient unto itself, and unconscious of the needs of its fellow nations near and far. At present the zinc industry stands on all fours with copper. Facilities for the production of both metals were so stimulated by war necessities, that the zinc industry is able to produce today more metal than the normal market can absorb or is likely to need for some years.

Turning aside from these pessimistic and oppressive facts, it is pleasant to consider briefly what a truly wonderful country is this Joplin region. Rich soil, mild climate, excellent railroad facilities, good roads, a neighboring supply of coal, natural gas, some relatively inexpensive hydro-electric power, and the great oil fields of Oklahoma and Kansas but a few miles distant. In brief, it would be difficult to find a more favored region in this much-favored United States.

In the face of the extraordinary advantages of location can it be maintained that the Joplin lead and zinc industry needs the stimulus of a protective duty on imported ores? Will not such an artificial incentive react in promoting and maintaining wasteful domestic practices that could not survive were it necessary to meet competition? Is it not going contrary to human nature to expect any other result? Is not our whole American protective theory based on the questionable premise that our higher scale of living and wages demands safeguarding from competition of goods produced by people living on a lower plane? There is no doubt we live in a manner which we believe to be better than that of any other nation in the world. Whether we are actually any better or happier for it is another question. At any rate in the case under discussion should not freight rates and the extraordinary natural advantages I have enumerated afford all the protection any mining, metallurgical, or manufacturing industry established in the Joplin district has any right to expect? Why burden a whole nation with the increased costs of a commodity if the only result is encouraging slipshod, wasteful practices, and providing inordinate profit to a favored few rather than as a reward of skillful, thrifty, and sound business methods?

There was a time in our national history, not so many years ago, when a high protective tariff was needed, and results, in encouraging the establishment of new American industries, subsequently justified it, but are we now, as the leading industrial nation of the world, justified in creating a new high protective tariff as a general policy? Doubtless in some cases it ought to be done, where special conditions exist against which it would be hopeless to compete. An instance would probably be that of metallic zinc smelted in Mexico and by the German smelters of Silesia and Poland. Joplin ores, however, should be beyond competition. They are incomparable in themselves, and are produced under such favorable conditions that the mining situation of the whole district would seem to be impregnable.

The tariff is an extremely controversial subject; opinions regarding it are usually influenced by self-interest and local sentiment. But the time has now arrived when we ought to have the courage to put these questions to ourselves and answer them in what we would honestly consider to be for the best interests of the whole country and for the sensible conservation of our mineral resources, irreplaceable and not limitless.

## Phosphate in Tunis

BY HENRY L. GEISSEL

Written for *Engineering and Mining Journal*

The production of phosphate is one of the principal industries of the French Protectorate of Tunis. According to official figures just published in the "Statistique Générale de la Tunisie," the exports of phosphate during the last few years were as follows:

| | Tons | Total Value in Francs | Price per Ton in Francs |
|---|---|---|---|
| 1910 | 1,334,000 | 29,354,000 | 22.0 |
| 1913 | 2,072,000 | 45,522,000 | 21.98 |
| 1915 | 1,170,000 | 26,910 000 | 23.0 |
| 1917 | 677,000 | 23,681,000 | 34.98 |
| 1919 | 1,075,000 | 48,385,000 | 45.01 |

Before the outbreak of the war the annual exports increased in quantity, though the price decreased. Exact figures for 1920 are not available, but it is safe to say that production did not exceed that of the previous year. The Tunisian phosphate industry is hampered seriously through want of laborers. For this reason Italy has to place a certain number of workmen at the disposal of the Tunisian authorities, in order to obtain sufficient phosphate for the requirements of the country.

The price for phosphate, which from 1910 to 1913 showed a declining tendency, has largely increased again, chiefly on account of the enormous increase in wages and raw materials, such as coal.

The principal importers of Tunisian phosphate were:

| | France | Italy | Germany | England |
|---|---|---|---|---|
| | In 1,000 Metric Tons | | | |
| 1910 | 501 | 350 | 62 | 175 |
| 1913 | 690 | 453 | 185 | 181 |
| 1915 | 342 | 399 | ... | 197 |
| 1917 | 143 | 226 | ... | 205 |
| 1919 | 184 | 335 | ... | 242 |

At present the bulk of the Tunisian phosphate is shipped to France and Italy. England takes third place, although in 1918 that country received as much as France and Italy together. On account of the war, the exports to Germany have ceased entirely.

## Differential Flotation Tests on Galena-Sphalerite Ores

The U. S. Bureau of Mines has recently issued an interesting bulletin (No. 205) descriptive of experimental work carried on in the Cœur d'Alenes. The general conclusions reached, which of course apply only to the lead-zinc ores of the Cœur d'Alene district in Idaho, are interesting:

1. A complete separation of the lead and zinc sulphides by differential flotation is impossible, owing to the intimate association of the minerals.

2. Fine grinding is essential to liberate most of the sulphide minerals and to permit their separation by differential flotation.

3. A better recovery is possible with an ore that has been crushed wet than with one that has been crushed dry.

4. A pulp density of about 2½:1 to 3½:1 (water to solids) seems to give the best differential selection and mineral recovery at normal temperature.

5. Each ore seems to require a somewhat different flotative mixture and the effect of a certain oil or chemical on one ore may differ from that on another similar ore.

6. Differential flotation effects a more satisfactory separation of the sulphide minerals than has been obtained by existing methods.

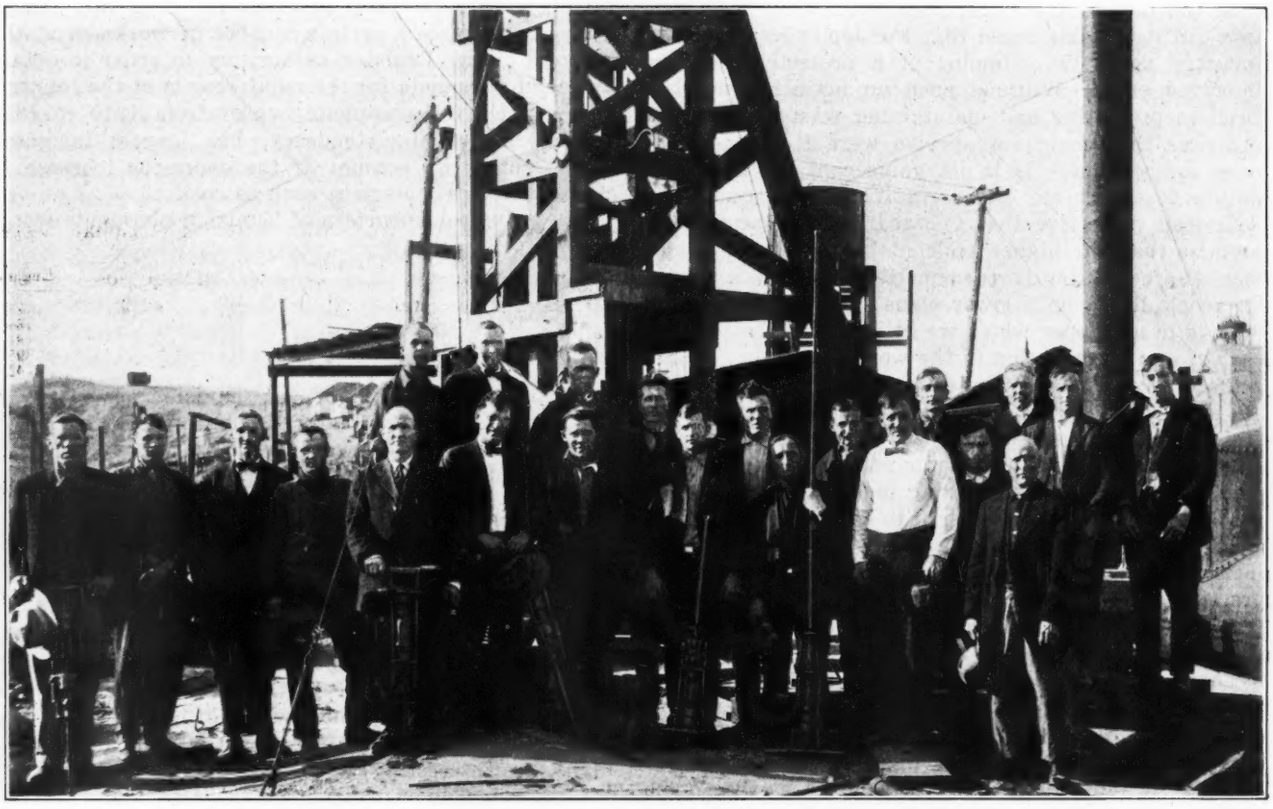
7. A better differential selection of the lead from the zinc sulphide is effected with an alkaline or neutral pulp than with an acid pulp.

8. The quantity of the chemical or flotation agents used in the small-scale tests can be reduced in large-scale tests or in practice.

9. Soda ash, sodium hydroxide, sodium silicate (water glass), salt, lime, coal-tar creosote, alcohol, gasoline, and charcoal seem to assist in the selective separation and recovery of lead sulphide in the presence of zinc and iron sulphides. Their effectiveness, however, may be modified by the gangue constituents of the ore.

10. Copper sulphate or some other copper compound, such as copper carbonate, when added to a pulp containing soda ash after the lead concentrate has been removed, seems to give good results in floating the zinc mineral in some of the ores.

11. The Bradford $SO_2$ process seems to be adaptable to the separation of the lead and zinc sulphides of some ores.



SHAFT-SINKING CREW AT VAN DYKE NO. 1 SHAFT, MIAMI, ARIZ.

# Sinking Van Dyke No. 1 Shaft

## Conditions Under Which Operations Were Conducted Permitted Good Progress, And at One Time the World's Shaft-Sinking Record Was Claimed—Plugger Drills Used as Moiling Machines—Gila Conglomerate Stated To Be Dry Formation

BY E. R. RICE
Written for *Engineering and Mining Journal*

THE property of the Van Dyke Copper Co. is situated at Miami, Gila County, Ariz., and at the southeast end of what is locally known as the "Miami mineral zone." This area, which is the locus of the orebodies of the Miami and Inspiration mines, is a crescent-shaped zone of mineralization, and as developed to date is about two miles long and approximately 2,000 ft. in width at its widest part. The relation of the zone of mineralization to the properties of the district is shown in Fig. 1.

The orebodies of the Miami and Inspiration mines are of the disseminated chalcocite type, typical of that group of mines generally classed under the head of "porphyries." The greater part of the ore developed in the district occurs in the Pinal schist, though important orebodies are found in the Schultze granite in some places where it has intruded the Pinal schist. The depth at which the present developed ore occurs below the surface of the ground varies from 200 ft. to 1,200 ft.[1]

The eastern end of the Miami mineral zone has been faulted downward by the Miami fault, the fault limiting the main orebody of the Miami mine on the southeast. Locally the Miami fault strikes N. 22 deg. E. and dips to the southeast at an angle of 46 deg. On the northwest (foot-wall and up-throw) side of the fault occur the present developed orebodies of the district, and all geological evidence obtainable points to the probability of ore of similar character being found on the

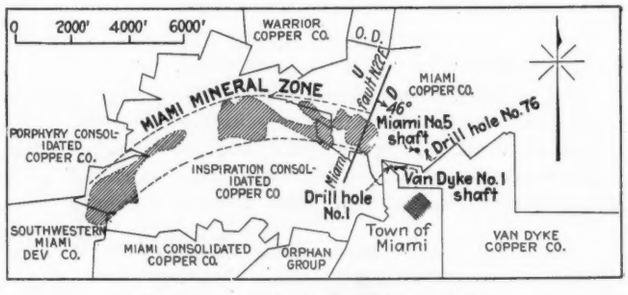



FIG. 1. MIAMI MINERAL ZONE

hanging-wall or down-throw side of the Miami fault to the southeast. The surface rocks to the northwest (locally) of the Miami fault consist of Pinal schist, with intrusions of Schultze granite; those to the southeast are Gila conglomerate, which has been faulted downward

[1]For detailed information concerning the geology and ore occurence of the Miami district see "The Copper Deposits of Ray and Miami, Ariz," by F. L. Ransome. U. S. Geological Survey, *Professional Paper* 115.

against the schist and granite. The Gila conglomerate is of later origin than any other formation in the district and was deposited subsequent to ore deposition and the ensuing secondary enrichment. Consequently, no surface criteria are obtainable to guide one in the search for ore beneath the conglomerate.

The property of the Van Dyke Copper Co. lies to the southeast of and on the hanging-wall side of the Miami fault and is in line with the probable extension of the Miami mineral zone. Drilling operations for exploration purposes were started in 1916, operations being confined to that portion of the property near that of the Miami Copper Co. At the time of starting drilling operations the thickness of the Gila conglomerate as well as the vertical displacement of the Miami fault were unknown, as drill hole No. 76 of the Miami Copper Co. was reported to have been abandoned in Gila conglomerate at a depth of 2,050 ft. Miami No. 76 drill hole is about 1,300 ft. northeast of Van Dyke No. 1 drill hole. No. 1 drill hole of the Van Dyke Copper Co. encountered an orebody of commercial grade at a depth of 1,170 ft., which continued to a depth of 1,219 ft., at which depth the hole was lost. This orebody was composed of silicates and carbonates of copper. No. 1 drill hole indicated that the thickness of the Gila conglomerate was 730 ft., although at the time of drilling this hole the evidence was not accepted as conclusive, on account of the Gila conglomerate (locally) being composed entirely of fragments of Pinal schist near its base.

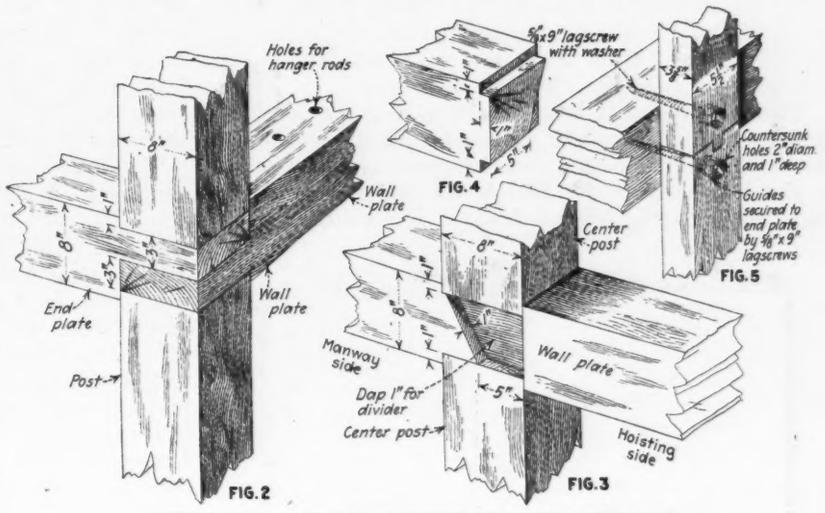
Owing to war conditions, drilling was discontinued early in 1918, and when development work was resumed, in 1919, it was decided to sink a shaft near No. 1 drill hole and carry on exploration by underground methods. The main reasons for this decision were the high cost of drilling and the great danger of losing deep holes. The shaft which is known as Van Dyke No. 1 was started in the spring of 1919 and is intended for development and exploration purposes only. As the probabilities of this ever being used as a working shaft are remote, it was the policy of the management to keep equipment and operating expenses at a minimum.

The shaft is of two compartments, measuring 6 ft. x 11 ft. outside the timbers. Lining sets are of 8-in. x 8-in. timber placed 5 ft. center to center excepting in bad ground, where the interval was made smaller, depending on conditions. Lagging is of 2-in. x 12-in. plank, the shaft being lagged solid. Guides are of 3⅝-in. x 5½-in. clear, straight-grained Oregon pine, having a length of 15 ft. Sollars are placed every 15 ft., or three sets. Inclined ladders are used, the opening in the sollar being under the ladder above. Framing details are shown in Figs. 2, 3, 4, and 5.

To a depth of 760 ft. the shaft is in Gila conglomerate, and a novel method was employed for sinking through this formation. Locally the Gila conglomerate is composed of unconsolidated fragments of Schultze granite and Pinal schist, though near the base it is made up entirely of schist fragments. The fragments composing the Gila conglomerate range from clay and sand to boulders several feet in diameter. It is too hard to pick, and is difficult to drill, on account of the raveling and the holes. To one familiar with this formation, the term "hard-pan" comes nearer describing it than any other.

The main features in the method to be described were first used by the Foundation Co. in the sinking of the No. 5 shaft of the Miami Copper Co., which is situated about 1,000 ft. northeast of the Van Dyke No. 1. In this method the "plugger" type of drill is used as a moiling machine, and the practice of moiling out the entire shaft section is followed.

In the practical application of this method, a trench or sump wide enough to hold the sinking bucket and about 18 in. deep is removed across the center of the shaft and at right angles to the long axis of it. The two benches left are then moiled off, and the operation is repeated. In the sinking of the Van Dyke shaft, the following procedure was followed: A cut was started at the point *A*, Fig. 6. This was done by the machinemen driving their bull pick bits down so as to form a V as shown in Fig. 7, and then prying up the material in the V, using their machines and steel as a prying unit. The first V would be about 12 in. deep, and this would be enlarged by successive cuts until a sump was formed at *A*, Fig. 6, about 18 in. deep and wide enough to hold the bucket. This sump would then be extended across the shaft as shown by the dotted lines in Fig. 6.




FIGS. 2, 3, 4 AND 5. TIMBER FRAMING DETAILS

After the completion of this work benches about 18 in. high at each end were left. One machine man and one mucker worked each of these, the machine man standing on the bench and the mucker in the sump. The method of moiling off the bench is illustrated by Fig. 8. The machineman would drive his steel down about 8 in. from the face of the bench, and then, using his machine and steel as a prying unit, he would pry off the ground between his steel and the face of the bench. As he worked across the shaft, he practically had two free faces to break to at all times. The mucker shoveled directly from in front of the machine, and a large proportion of the broken muck fell on his shovel. That which did not, lay on a comparatively smooth bottom, and was easy to shovel. A machine man kept one mucker busy, so that there was no waiting. The drill was running constantly, and as soon as the machine man had pried off one bite, he immediately lifted his machine and started on another cut.

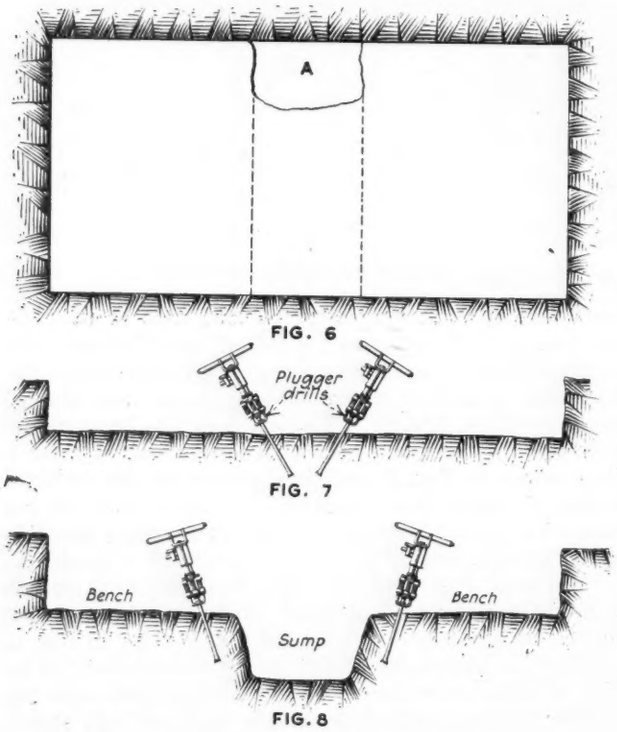
The drills used were the Waugh Clipper No. 55. To develop a more powerful blow and to save air, the blow

valves and ratchets were removed from the machines and the hammers were plugged. Although no measurements were made to determine how much this increased the efficiency of the drills as moiling machines, the improvement appeared to be about 75 per cent.

### WATER HANDLED BY BAILING

Sinking was started with one shift per day and was continued on this basis until the shaft had reached a depth of 700 ft. Water was struck at 300 ft., and by the time the shaft was 700 ft. deep the flow had increased to such an extent that it was decided to operate three shifts. Water was handled entirely by bailing, as it was regarded as inadvisable to install pumps while the shaft was in the Gila conglomerate. This flow of water increased from 5,000 gal. to about 10,000 gal. per day soon after the schist was reached.

When a three-shift basis was started it was decided that we had an excellent chance to break the world's record for shaft sinking, so a telegram was dispatched to the *Engineering and Mining Journal* for data and the following reply was received: "New world's record




FIGS. 6, 7 AND 8. METHOD OF MOILING

claimed at Crown Mines, Johannesburg, South Africa, where circular shaft 20 ft. in diameter was sunk 279 ft., or from 655 to 934; average speed 9 ft. in twenty-four hours, during December, 1918. Previous world's records also held at Crown Mines, where 252 ft. was made in thirty-one days at No. 14 circular shaft."

On Feb. 1, 1920, the shaft was measured by an independent engineer, and on that date we "started after" the world's record. The shaft was 755 ft. deep and in Gila conglomerate. On the night shift of February 1, the shaft passed out of conglomerate at a depth of 760 ft. and entered Pinal schist, which is of a different character than the Gila conglomerate. In places the schist was badly shattered, and moiling could be used to advantage. In other places the ground was hard and required blasting. Where sloughing ground was encountered it was necessary to use short sets and keep the timber right down to the bottom, using spilling and lacing below the bottom set.

In blasting, eighteen-hole rounds were put in, using the center V cut. The cut holes were drilled 10 ft. in depth and the squaring-up holes 9 ft. Blasting was done with delay-action detonators, using 200-v. alternating current for ignition.

### WORLD'S RECORD CLAIMED

Thirty-one days after starting on this program the shaft was again measured by an independent engineer and found to be 1,063.2 ft. deep, which showed a progress of 308.2 ft. in thirty-one days. The actual working time was approximately twenty-nine and two-thirds days. We claimed the world's record, although I understand the Crown Mines now claim it with a progress of 310 ft. in thirty-one days, or 1.8 ft. more than our record.

The following figures giving footage per shift from surface to a depth of 1,063 ft. are interesting: The actual number of shifts employed in sinking this depth was 305. This gives an average progress per shift of 3.48 ft. or, considering a 93-shift per month basis, is equivalent to a progress of 323.6 ft. per month, or 10.44 ft. per day actual working time. I think we are safe in claiming the world's record for sinking 1,063 ft. in 305 working shifts. There was a total (surface and underground) of 2,296 man shifts employed to this depth, making a progress per man shift of 0.46 ft. of completed shaft. This work included framing timbers, hoisting, blacksmithing, sinking, timbering, lagging the entire shaft section, putting in guides, air pipe, sollars every fifteen feet, ladders, and other complementary work—in other words, the making of a finished shaft.

### DETAILS CONDUCIVE TO SPEED ADOPTED

The shaft sinking was done on contract. In hiring men, the contractor employed only experienced shaftmen, who were paid substantially more than the prevailing rate of wages in the district. Every man had a specific duty to perform; consequently he became proficient in that particular operation. The plan also served to fix responsibility for all details of the work. A normal crew consisted of a hoisting engineer, who looked after the compressor; a top man, and five men in the bottom of the shaft, one of whom acted as jigger boss. Besides these men there was an extra man on day shift, who framed the timbers and sharpened steel with the help of the top man. Only four out of the five men worked in the bottom, excepting when timbering was being done. The fifth man rested. This allowed a man to rest 20 per cent of his time, which enabled the crew to work at top speed. Not only were they able to do this on account of the rest obtained, but they had no psychological reason for doing otherwise. In other words, they had no excuse to "taper off."

In blasting ground, the method of operation was similar to good practice elsewhere, although in this instance the moiling machine was used in conjunction with regular blasting operations. After a round had been mucked out, it was always possible to moil a foot or so of shaft below the area broken by the blasting, thereby giving an extra foot of shaft with no extra blasting and with little time and expense. This also left the bottom in good condition for drilling the next round.

All timbering operations were standardized. Each

man on the job always knew what the next detail of the work would be, knew when it would start, and knew his part in the general plan. When the drilling crew was ready to timber, the men gave the engineer a prearranged signal, and two of them were hoisted about 100 ft. up the shaft, where they removed four hanger rods. (Hanger rods were left in for about 100 ft. above the bottom. In bad ground they were left in permanently; in which case, new hanger rods were sent down from surface.)

In the meantime, the other three men were getting everything in readiness for timbering. While the hanger rods were being put in the last set, the bucket was sent to surface and detached from the cable by the top man, who in the meantime had the two wall plates in readiness for lowering. The wall plates were attached to the cable by means of a large clevis, the clevis bolt being placed in the hanger-rod holes in the wall plates. As soon as the wall plates were detached from the cable, it was sent to surface, and the water bailer was attached in place of the regular sinking bucket. The bailer was of 25-cu.ft. capacity and the sinking bucket was of 13 cu.ft., consequently the former was better adapted to handling timber, blocks, and wedges on account of its greater size. It was also in position to bail the water that had accumulated during the course of timbering as soon as it was necessary to do so.

The end plates and posts were then sent down, arriving at the bottom about the time that the wall plates had been swung into position. The end plates were then put on the posts placed in position, and the set was pulled into place by the hanger bolts. The set was then lightly blocked into approximate position by means of temporary blocks. In this way it was possible to judge the exact size of the blocks to be used. These were then split to the proper dimensions, the temporary blocks removed, and the permanent ones inserted. When all permanent blocks were in place, the set was wedged to its final position.

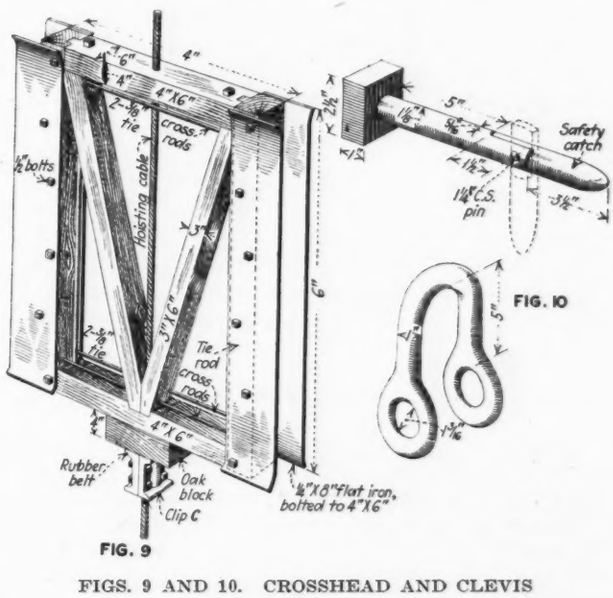
In blocking the set, a 2-in. x 12-in. timber about 18 in. long was placed next to the set at the joint, so that the blocking pressure would be evenly distributed over the entire joint. Alignment was maintained by means of plumb lines in three corners of the shaft. After the set was blocked the divider of the set above was put in and the blocking at the center of that set securely wedged. The divider of the last set was always left out to simplify handling of the bucket and working in the bottom. The lagging was then put in place, securely blocked and filled, so that the ground could not slough more than the length of one set.

While four men were finishing up the lagging, the fifth man bailed out the water, and by the time the timbering was finished the bailer could be taken off and the sinking bucket put in place ready for the resumption of sinking operations.

In timbering, each man worked on a certain corner, while the fifth man unloaded timbers, handled the bucket, and rendered general assistance to the other men. This arrangement afforded a crew of four individual units, one at each corner, which combined to make two crews of two men each at each end of the shaft. With the same man handling the same corner all of the time, the men became very proficient, as they soon learned each other's peculiarities and methods and worked together like a well-trained team. Also, by this arrangement, it was easy to fix responsibility for any part of the work. In framing timbers, most of the framing was done by means of a 26-in. cut-off saw which was driven by a belt placed on one of the flywheels of the air compressor.

The crosshead used is shown in Fig. 9. The guide shoes extend the entire length of the crosshead, and are formed by bolting ½-in. x 8-in. flat iron to the 4-in. x 6-in. side pieces. In sinking, the cable passes freely through the crosshead, which is carried by the clip *C* on the cable. This clip is in two halves and is clamped to the cable by bolting the halves together. It was originally a shaft coupling, and serves its function as a clip admirably. It is flat on the top, and permits the cable to rotate freely in the crosshead. This is important in sinking operations, for in most instances where the cable has broken while sinking, the point of failure has been at the place where the clip is attached to the cable.

Failure of hoisting cables is usually caused by a combination of three features of operation: First, by strain put on the cable by the clip as it comes up against the




FIGS. 9 AND 10. CROSSHEAD AND CLEVIS

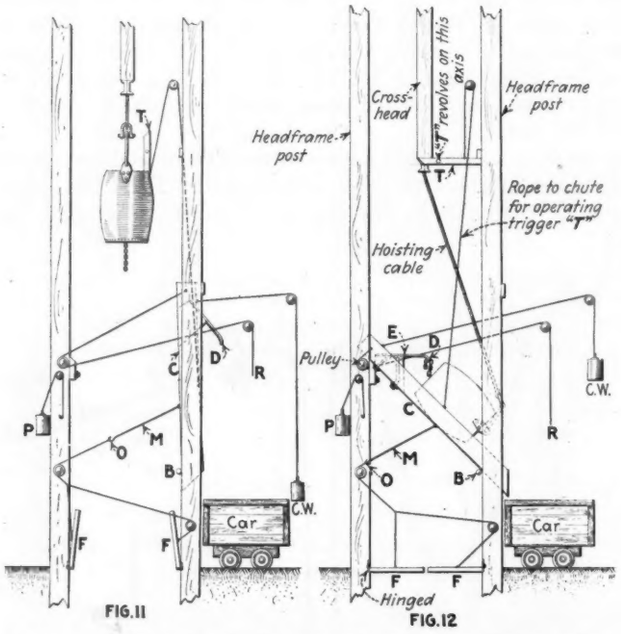
stationary crosshead resting on the bumpers; second, by bending of the cable at the point where the clip is attached—this being caused by the bucket swinging pendulum-like under the crosshead as it passes up and down the shaft, and, third, by the rotation of the cable being suddenly arrested when the clip comes up against the crosshead, which is caused by using a clip that will not allow the cable to rotate freely in the crosshead.

If a loaded bucket is hoisted from the bottom of the shaft, by the time the clip has reached the crosshead at the bumpers—fifteen to forty feet above—the cable is untwisting rapidly, and the heavily loaded bucket has acquired a strong movement of rotation about its vertical axis. If the clip on the cable is such that this rotation is suddenly stopped when the clip comes up against the crosshead, the effect is to place severe alternating stresses on the cable at the point where the clip is attached. My personal belief is that the third cause of failure is more dangerous than the other two combined. By using the clip described, the rotation of the cable is brought to a gradual stop and the twisting and untwisting below the crosshead, caused by using a clip that does not allow the cable to rotate, is practically eliminated. Allowing the cable to rotate freely in the

crosshead, in addition to hanging the crosshead on a trigger while the bucket is being dumped, will aid considerably in preventing cable breakage. In sinking the Van Dyke shaft, about 15 ft. was cut off the cable every three or four weeks.

Fig. 10 illustrates the type of clevis and pin used to attach the bucket to the cable. A regular thimble was used in the end of the cable and was attached to it by means of four Crosby wire-rope clips.

Hoisting buckets of 13-cu.ft. capacity were used. The general arrangement of the dumping apparatus, shaft




FIGS. 11 AND 12. DIAGRAMS SHOWING HOISTING AND LOWERING OF BUCKET

doors, and other operating devices, is shown in Figs. 11 and 12. Fig. 11 shows the position of the bucket, chute, trigger, counterweights, and doors just after the bucket has been hoisted and is ready to be lowered for dumping, and Fig. 12 illustrates their position after the bucket has been dumped. When the bucket has been hoisted, the top lander pulls the rope *R*, Fig. 11. This causes the different pieces of apparatus to take the positions shown in Fig. 12, with the exception of the bucket, which is shown in the position it assumes after having been dumped. The bucket is then lowered to the swinging chute *C*, the chain attached to the bottom of the bucket engaging in the catch *D*. The edge of the bucket strikes the block *E* which causes it to dump and assume the position shown in Fig. 12.

It will be seen from the figures that when the top lander pulls the rope *R*, the chute *C* drops into the dumping position, the doors *FF* are closed over the collar of the shaft, and the trigger *T* drops into a horizontal position so that it will support the crosshead while the bucket is being dumped. By closing the doors the danger of rocks falling down the shaft is eliminated. A little psychology is here at work, for although there is not much danger of a rock falling down the shaft if the doors are *not* closed, nevertheless one *might*. By holding the crosshead up while the bucket is being dumped serious bending strains on the cable are lessened.

After the bucket has been dumped and hoisted so as to clear the chute the top lander pulls the counterweight *CW* and the chute, doors and other parts return to their normal position shown in Fig. 11.

In constructing a dumping arrangement of this type, the main considerations are the proper weighting of the different components and the adjusting of the positions of the different ropes and pulleys. This is done best by a cut-and-try method. To anyone duplicating the arrangement shown I suggest that the angle of the chute be made at 45 deg. with the horizontal when in the dumping position. Make the catch *D* strong, preferably out of pick steel, and bend the end of the catch downward at an angle of 45 deg. Bolt the block *E* and the catch *D* securely to the chute and make the shaft or axle *B* very strong, preferably out of 2-in. shafting if obtainable. The pulleys should be of at least 4-in. diameter, and flexible light-wire cable should be used for the operating doors.

When timbering operations are going on, the chute *C* is in the position shown in Fig. 11, but it is necessary to open and close the doors *FF* for changing buckets, handling timber or other work. To simplify handling the doors, the rope *M* is provided with a ring and hook at *O*. By unhooking at this point, the rope to the doors can be connected to the counterweight *P*, which almost balances the weight of the doors, and they can then be raised and lowered at will, independent of the chute and with little effort.

## Relation of Shaft to Geology of District

The Van Dyke shaft, being the first working to penetrate the conglomerate east of the Miami fault, is of more than ordinary interest from a geological standpoint. Although the lateral work done from the shaft is not yet sufficient to clear up all obscure points, some interesting data have been obtained. The following is a log of the shaft from collar to bottom:

0 to 760 ft. formation is Gila conglomerate.

Water struck at 300 ft., the total flow being 5,000 gal. per day at the base of the conglomerate and increasing to 10,000 gal. per day when the shaft had reached a depth of 1,100 ft.

Pinal schist entered at depth of 760 ft.

Leached Pinal schist from 760 ft. to 1,183 ft., showing small amounts of chalcotrichite.

Orebody composed of carbonates and silicates of copper extending from 1,183 ft. to 1,218 ft.

1,218 ft. to 1,430 ft. Pinal schist showing small amounts of chrysocolla, malachite, azurite, cuprite, and native copper.

1,430 ft. to 1,595 ft., Pinal schist carrying chalcocite in stringers and disseminated grains.

1,959 ft., top of primary zone. Schist carrying pyrite and chalcopyrite.

Granite (dike) from 1,610 ft. to 1,635 ft.

1,635 ft., encountered Miami fault.

1,635 ft. to bottom of shaft at 1,692 ft. consisted of fault drag composed of fragments of Pinal schist.

For several years, in fact ever since the discovery of the Miami orebody and the realizaton of the fact that probably a portion of this orebody has been faulted downward toward the southwest by the Miami fault, there has been much speculation as to the amount and direction of displacement of the Miami fault. Nothing can be learned from an investigation of the surface, as the country to the southeast of the fault is composed entirely of Gila conglomerate. The Miami Copper Co. drilled its No. 76 hole to a depth of 2,050 ft. (Fig. 1) and reported the hole in conglomerate for the entire distance.

F. L. Ransome in *Professional Paper* 115, "The Cop-

per Deposits of Ray and Miami, Ariz.," p. 178, says, "The search for ore under the Gila conglomerate between Miami and Globe would be greatly facilitated if the direction and amount of displacement of the Miami fault were known. The present investigation gave no clew to this much-desired information, and although special study devoted to this particular problem might possibly lead to its solution, it is difficult to see what line of attack would be likely to yield definite results. One suggestion is that a careful study be made to determine the character and amount of the displacement of the Main porphyry dike in the Miami workings. This is cut off, of course, by the Miami fault, and it is as difficult to predict where its eastern continuation may be found as to determine the position of a possible continuation of the Miami orebody beyond the fault."

The collar of the Van Dyke shaft is 3,630 ft. above sea level. The elevation of the schist on the foot-wall side of the Miami fault is 3,775 ft. The elevation of the contact between the conglomerate and schist in the Van Dyke shaft is 2,870 ft. Disregarding erosion of the foot-wall side of the Miami fault subsequent to faulting, tilting of the faulted blocks, and other features, this would give a minimum throw of approximately 900 ft.

The upper limit of the chalcocite zone is found in the Miami mine (foot-wall side) at an approximate elevation of 3,500 ft. The upper limit of the chalcocite zone was struck in the Van Dyke shaft (hanging-wall side) at an elevation of 2,200 ft. Assuming the upper limit of the chalcocite zone to be horizontal, and disregarding downward migration of chalcocite since faulting, this would give a throw of 1,300 ft.

Nothing was found during the course of sinking that would throw definite light on the amount of lateral displacement of the Miami fault, if any. The answer to this problem will not be had until more extensive work has been done in the schist on the hanging-wall side. Work that promises to give an early solution to this question is now in progress by both the Miami and the Van Dyke companies, the former being engaged in deepening its No. 5 shaft and the latter doing lateral exploration on its 1,550-ft. level.

In closing, I desire to refute the statement made by a prominent engineer to the effect that the Gila conglomerate, locally, is a wet formation. In the course of extensive churn drilling, covering the district from end to end, I have invariably found the Gila conglomerate to be what is known as a dry formation. The water occurrence in the conglomerate passed through by the Van Dyke shaft may be described as typical of the entire formation.

## Southern Rhodesian Mineral Production

Southern Rhodesia's mineral production for 1920 was valued at £4,450,988, as compared with the 1919 total of £3,519,375, according to the Government Mining Engineer's report. The principal increase was in gold, which, despite a decrease in weight of 40,724 fine ounces, increased in value by £557,051, from £2,499,498 to £3,056,549, which includes £680,496 resulting from the gold premium. Asbestos production nearly doubled, the 1920 output being 18,823 tons, as against 9,799 tons in 1919. The value, however, increased only from £425,-240 to £459,572.

# An Underground Party at Virginia City in the 70's

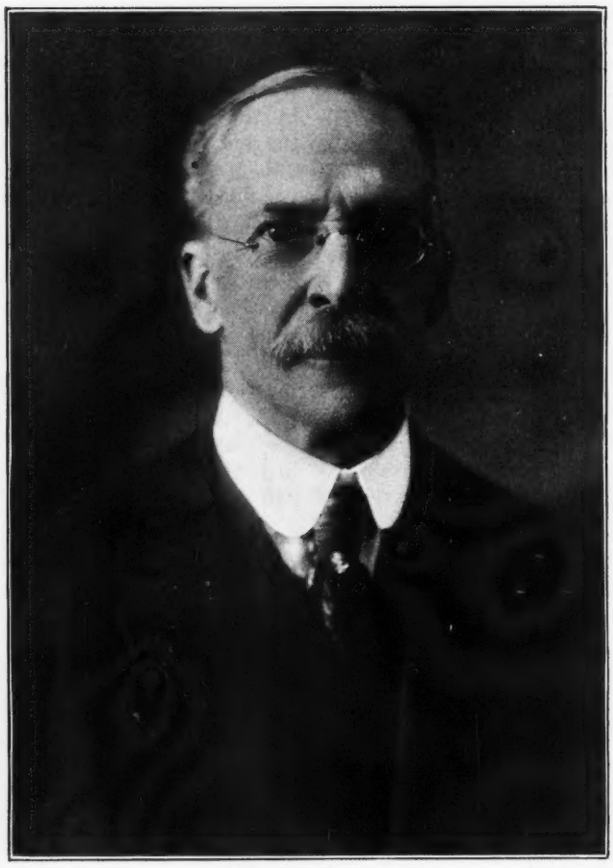
*Photo by International, New York*

The illustration shows General U. S. Grant and members of his party on a visit to one of the mines at Virginia City on Oct. 7, 1879. The men in the photo were among the most distinguished Americans of their day. From left to right they are: John W. Mackay, promoter of the Mackay-Bennett Cable Co. and one of California's early millionaires; Mrs. D. Gillette; U. S. Grant, Jr.; Mrs. U. S. Grant; General Grant; Mrs. James G. Fair; Governor J. H. Kinkead of Nevada, and James G. Fair.

# Mining Engineers of Note

## Charles Warren Goodale

THE mining engineers of the United States have set an enviable standard in technical achievement. Better than this—they have also established a character standard of American manhood. As a rule, they are strong on performance and weak on publicity. Charles Warren Goodale is no exception. Outside of his immediate circle, few know the stepping stones in his career. That he is, however, held in high esteem is shown by the recent action of the Mining and Metallurgical Society of America in awarding him its annual medal. Mr. Goodale was born in Honolulu, Hawaii, in 1854. Both of his parents, Warren Goodale and Ellen R. Whitmore Goodale, came from Marlboro, Mass. He attended the English High School of Boston and the Massachusetts Institute of Technology, graduating from the institute in 1875. He was first employed by the Boston & Colorado Smelting Co. in Boston, and in 1876 he went for the same company to Black Hawk, Col., remaining until 1880, when he became superintendent and manager of the Boston & Arizona Smelting & Reduction Co. at Tombstone. From 1885 to 1898 Mr. Goodale was superintendent of the Colorado Smelting & Mining Co. at Butte, and during the last five years of that time he was employed as consulting engineer for the Montana Mining Co., Ltd.



C. W. GOODALE

In 1898 Mr. Goodale became affiliated with the Boston & Montana Consolidated Copper & Silver Mining Co. For three years he was superintendent of the smelter at Great Falls, when he was promoted to be assistant manager. In 1912, when Frank Klepelko resigned as manager, Mr. Goodale became his successor and returned to Butte. When the Boston & Montana and other companies were merged with the Anaconda Copper Mining Co., Mr. Goodale was appointed to his present position, chairman of the Bureau of Safety of that company.

From the beginning of mining operations in Butte the companies gave attention to the safety of their men, but it was not until 1914 that safety departments were organized. At that time the Anaconda Copper Mining Co. began systematic investigation of the causes of mine accidents. Safety engineers were appointed in all departments, and safety committees co-operated with the engineers and workmen.

In January, 1915, the Bureau of Safety began the publication of a monthly paper. It was called the *Anode*, and is one of the pioneers of many similar publications. Encouragement is given the company employees to contribute articles and partake in discussions. The potent appeal of the "movie" film was not overlooked, and the Safety Department has shown about 9,000 ft. of films, telling the story of "From Ore to Metal" and weaving into this story many illustrations of bad practices and their consequences. The Butte mines are deep, the number of men employed under normal conditions is in excess of 10,000, and the tonnages handled are large, necessitating a considerable use of mechanical appliances. As a consequence the safety work is an intricate problem and greatly dependent for its success upon thorough co-operation of the men. Through the efforts of Mr. Goodale and his assistants, the improvement in conditions has been marked. During Mr. Goodale's life in Butte the ventilation of the mines has been systematized and improved. Mechanical haulage has supplanted hand tramming to a large extent. Compressed-air operation of hoists has displaced steam.

Mr. Goodale lives in Butte. In addition to his duties in improving operating conditions in the metal and coal mines of the company, and in its reduction works, he finds time to be president of the Barnes-King Development Co. He is a member of the two mining societies and of the British Institute of Mining and Metallurgy, the American Mining Congress, the Colorado Scientific Society, and the Montana Society of Engineers. He belongs to the Engineers' Club, of New York; the Silver Bow Club, of Butte; the Montana Club, of Helena; the Anaconda, and the Butte Country Club.

In the American Institute of Mining and Metallurgical Engineers Mr. Goodale has served as manager, director, and vice-president. He has also contributed a number of important papers and discussions.

# CONSULTATION

## More Information About Iceland Spar

*Engineering and Mining Journal* occasionally receives inquiries requesting information about Iceland spar. The following extracts from a U. S. Bureau of Mines Report by Oliver Bowles, coupled with a reference to an article in *Engineering and Mining Journal* of July 31, 1920, will serve to inform those interested in the subject:

The most important use for Iceland spar is in the manufacture of Nicol prisms, which constitute an essential part of every polarizing microscope. The principle governing the construction of the Nicol prism is as follows: Ordinary light in passing through a crystal of calcite is resolved into two rays of plane polarized light vibrating in planes at right angles to each other, and having different indices of refraction. Thus the two rays follow different paths through the crystal. The prism of Iceland spar is cut diagonally and cemented together again with a transparent cement having an index of refraction intermediate between the two rays passing through the prism. Canada balsam is employed for this purpose. The prism is cut at such an angle that the ray having the greatest index of refraction meets the surface of the balsam at an angle greater than the angle of total reflection, and it is thus deflected to the side of the prism, while the second ray passes through. Thus one of the rays is eliminated, and polarized light vibrating in a single plane is obtained.

The behavior of polarized light in traversing various minerals is found to be a ready means of identifying them, and of studying their properties, and thus Iceland spar renders a service of inestimable value in the study of every known mineral with the possible exception of the opaque minerals, and it may be added that it is also useful in the study of certain industrial products.

Physical properties of Iceland spar that have a direct bearing on the mining methods employed are its perfect rhombohedral cleavage, a cleavage in three directions at oblique angles to each other, and its susceptibility to abrasion or scratching. The crystals cleave so readily that light blows will shatter them into fragments, and as they are soft enough to be readily scratched with a knife extreme care must be taken in handling them.

The best grade of optical spar sells at from $10 to $20 per lb. Specimen material commands a price of $1.50 to $2 per lb., and standardization spar about $1 to $2 per lb.

Crystals often show repeated twinning, the visual evidence of which consists of bands of bright rainbow colors, which appear when the crystal is viewed in transmitted light at an oblique angle, though such bands may be due also to air films in incipient fractures. The presence of defects due to twinning may in some crystals be readily tested by anyone with the aid of no equipment except a sheet of white paper. If a small clearly defined dot is placed on the paper and a cleavage fragment of Iceland spar placed over the dot, two dots will ordinarily appear a short distance apart, due to double refraction. If, however, the crystal is moved slowly back and forth, and the dots are observed closely, additional indistinct dots may also appear in certain positions. Such a phenomenon is an indication of twinning, and crystal fragments which exhibit it are defective for optical purposes, unless the individuals which constitute the twinned form are large enough for optical parts to be cut from them without passing beyond the plane along which such individuals are united (the composition face). In searching for any such evidence of twinning, observation should not be confined to one direction, but should be made in the three principal directions through the three opposite pairs of parallel faces.

The disposal of low-grade spar is a difficult problem. Small, clear crystal fragments may be sold to museums or to schools and colleges for illustration of optical properties. Also a limited quantity of pure material may be sold for use in preparing standardization solutions employed in volumetric analysis. Both of these uses probably do not require more than a few hundred pounds a year. Pure calcium carbonate is used for other purposes, as in the manufacture of high-grade glass, but for such uses its optical properties are not utilized, and any form of granular or opaque calcite of the requisite purity is equally valuable. Many limestone and marble deposits afford such a product, and consequently there is often no justification for the added transportation expense involved in utilizing spar waste. If some practical outlet could be found for the smaller cleavage fragments and the defective spar it would greatly simplify the problem of development in Montana deposits.

## Optical Fluorite

In *Engineering and Mining Journal* of Oct. 30, 1920, appeared a short statement on the subject of "Optical Fluorite." The remarks made therein have been amplified by Mr. B. Malishev, a mining engineer residing in Shanghai, China, who has transmitted comments which will prove informative to readers interested in this optical material, a particular variety of fluorspar, and which treat of some details not generally known:

"The colored variety of optical fluorite does not possess as great a disadvantage as is commonly supposed. It is possible to bleach the mineral by special heating methods, as is done by the Carl Zeiss Company. Sometimes fluorite free from all common defects possesses double refraction. Such material is not suitable for optical purposes. Double refraction occurs if the fluorite was formed in the ocean under a great pressure.

"The demand for optical fluorite is limited only by its high price for big pieces; otherwise fluorite would be used on a large scale not only for the finest microscopic objectives but also for photographic lenses. Efforts have been made to obtain optical fluorite from chemically pure calcium fluorite by fusion, but these experiments have not given practical results. Better results are obtained by fusing a mixture of boric acid and calcium fluorite. This mixture possesses nearly the same properties as optical fluorite.

"Prices vary widely, and for absolutely clear material in big pieces quotations may be as high as $25 per lb. Fluorite prisms for spectroscopic apparatus sometimes command a price of a few hundred dollars.

"The Carl Zeiss Company has sent expeditions prospecting for fluorite to several parts of the world, including Siberia.

"Good optical fluorite is found in the Transbaikal region (Siberia), in the Adun Chilon Mountain, near the Mongolia frontier. Here the fluorite occurs in well-formed crystals in nests, with different other sublimation minerals such as tourmaline and beryl. The rock material of the nests is converted under weathering conditions to a soft clay, so that the fluorite crystals may therefore be easily extracted without breaking or destroying them."

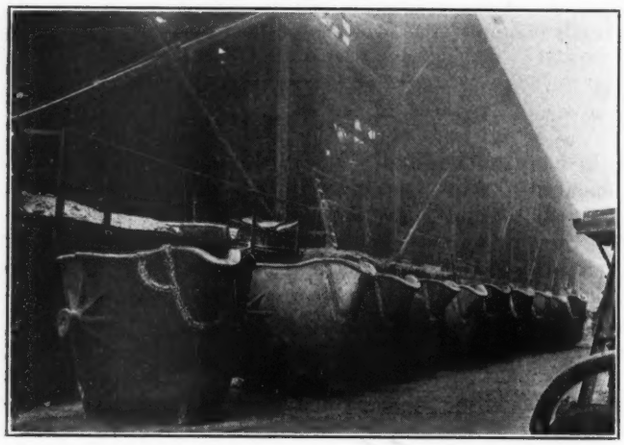
# HANDY KNOWLEDGE

## Welding Ladle Spouts at Garfield

BY E. J. HARRIS*
Written for *Engineering and Mining Journal*

Early in 1920 we found that the spouts of the cast-steel matte ladles at the Garfield smelter, at Garfield, Utah, were in such bad condition as to make it necessary either to buy new ladles or make substantial repairs on old ones, as the hammering action on the ladles, in cleaning out shells, had practically destroyed the spouts.

Repairs had been attempted prior to this by fitting a patch around spouts of sheet steel riveted, but with poor results. We determined before buying new ladles to try



TEN LADLES WITH WELDED SPOUTS, GARFIELD SMELTING CO., GARFIELD, UTAH

thermit welding in a new spout on one ladle as an experiment, which was done with such gratifying results that ten of these defective ladles were treated in the same manner, and we now have our matte ladles in first-class condition, at a quarter of the expense entailed in buying new ones. It may be of interest to follow this process through from beginning to end, as follows:

First we built a pattern for a new spout and had a cast-steel spout made from it. We cut out the old spout, making an allowance of 1 in. between the edges of the new spout and the space occupied by the old spout. We chamfered the edges of the ladle and the spout inside and out, making the edge of both V-shaped, and bolted the new spout in place, using three bolts for this purpose. Pattern wax was then prepared and molded in place the exact shape of the weld wanted, which was 4 in. wide at the body of ladle, 1 in. for space between spout and ladle, ½ in. each side for chamfering and 1 in. each side for a collar.

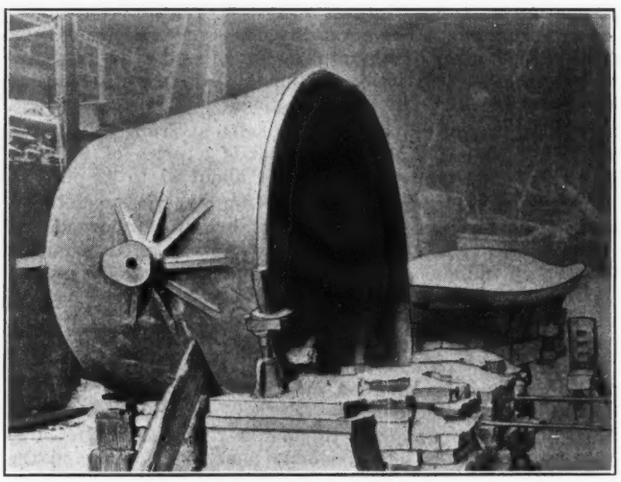
In molding the wax which gave the contour of the weld, a piece of ½-in. wire was placed in the center of the wax all round the joint. When the wax was set the wire was pulled out. The space occupied by the wire gave the heat a chance to circulate and hastened the removal of the wax when it was melted out after the mold was formed. A piece of small rope is sometimes used in place of the wire for this. The ladle was then tipped at an angle of about 90 deg., with the spout down. When in this position the pouring gates, of which there are two, one at each juncture of the spout with the ladle, are on the outside edge of the ladle and spout, the riser being at the base of the spout. Care must be taken to see that the riser is a trifle higher than the pouring gates.

A brick platform or mold was then built from the ground up to within 6 in. of the spout, heavily reinforced all around to prevent the pressure of the melted thermit from forcing its way through. The 6 in. between mold and spout was then filled with a mixture of silica sand, ground firebrick and fireclay in equal proportions by bulk. In mixing, particular care was taken to see that just enough water was used to allow the mixture to hold together. The mixture was then tamped as tightly as possible between mold and parts to be welded.

A small mold of brick was then made for the inside of the ladle, and the mixture of silica sand, ground firebrick and fireclay tamped in, arrangements being made for the riser, pouring gates, and pre-heating holes. The pre-heating holes were, of course, in line with the joint to be welded, and the pouring gates and riser on top of the joint to be welded, or inside the body of the ladle. The wax was then melted out by using the pre-heating torch, and the joint brought to a red heat, kerosene being used for this purpose in the pre-heating torches.

The matte ladles weigh 13,182 lb. and cost $1,318.20 each. The new cast-steel spouts weigh 832 lb. and cost $83.20 each. Material and labor to cut out the old spout and weld in the new one cost $355.37, so we are saving $962.83 per ladle, or a total of $9,621.30 on the ten.

It will be noted from the illustration that we are also welding in patches. All these welds have successfully withstood the battering action of knocking out the shells, which was the cause of breaking of the original spouts. No doubt, in time the new spouts will go the way of the old ones, but I am satisfied that the welds will not fail, as we are watching them closely, and so far there is not the slightest indication of trouble.



LADLE IN POSITION FOR WELDING SPOUT AND PRE-HEATING UNDER WAY

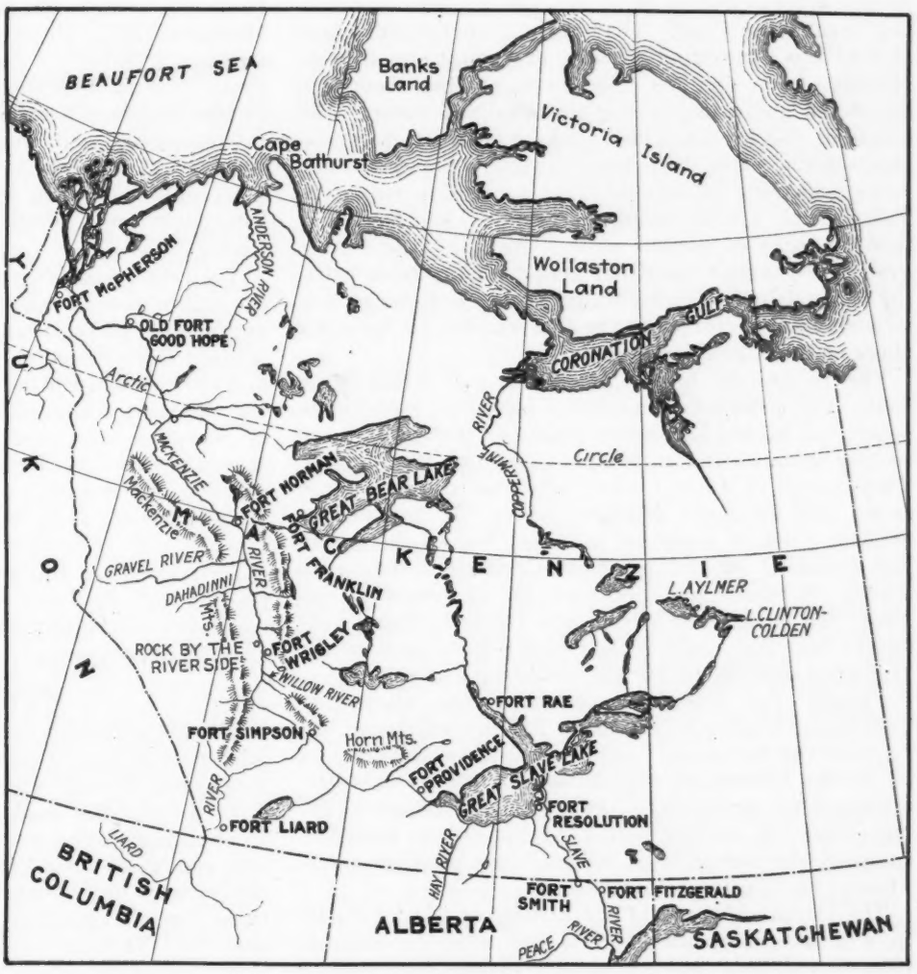
*Mechanical superintendent, Garfield Smelting Co., Garfield, Utah.

# THE PETROLEUM INDUSTRY

## Petroleum in the Canadian Northwest*

BY ARTHUR H. REDFIELD
Written for *Engineering and Mining Journal*

THE BRINGING IN OF A WELL forty-five miles north of Fort Norman, on the Mackenzie River, by the Imperial Oil Co., Ltd., on Aug. 25, 1920, opens up to development a large and little-known region in the Provisional District of Mackenzie, Canadian Northwest Territories. It is the purpose of this paper to summarize the known data relative to the geology, manner of occurrence, and character of the petroleum of these northern regions. A certain amount of exaggeration and a lack of definite data have characterized much of the discussion of this new oil discovery. The possible petroliferous zone comprises the entire Devonian area of the Mackenzie and Great Slave basins, and is placed by the Canadian Geological Survey at 300,000 square miles. The extent of this region cannot be defined with precision, as geologic exploration has evidently been confined to the banks of the rivers and lakes, and large portions of the forest- and tundra-covered interior are still unexplored. Not all of this area may be presumed to present structures favorable to the accumulation of petroleum in commercial quantities. Frederick G. Clapp in a recent statement[1] gives a warning, based on observation of the Mackenzie territory, against over-enthusiasm concerning the possibilities of the region. Three physiographic provinces may be distinguished in the Mackenzie basin. West of the Mackenzie River rises a rugged mountainous highland, which is a continuation of the Rocky Mountain cordillera of southern Canada and the United States. It forms a belt, varying in width from 20 to 200 miles, including the outlying foothills. East of the Great Slave and Great Bear lakes, and extending eastward to Hudson Bay, is a more subdued but rocky and partly treeless plateau, which is a continuation of the Laurentian plateau that almost encircles Hudson Bay. The central area is occupied by a broad, almost level forested plain, through which the Mackenzie flows northwestward to the Arctic Ocean, fed by swift mountain streams from the west and by innumerable lakes to the east. It is this central area which gives promise of oil production.




MAP OF MACKENZIE RIVER BASIN

As the Mackenzie basin extends over seventeen degrees of latitude, its climate inevitably shows considerable variations. The summer climate of the region is not governed so much by latitude as is that of the Northland winter. Owing largely to topographic conditions, the summer isotherms run in a northwesterly direction parallel to the Mackenzie River, showing that all points in the valley have nearly the same summer temperatures. The mean January temperatures of Fort Simpson range from 33.5 to 16.2 deg. F. below zero; the

*Published by permission of the Director of the U. S. Geological Survey.

[1]Note bibliography on p. 875 of this issue; also *Eng. and Min. Journ.*, Vol. 111, pp. 553, 554, March 26, 1921.

mean July temperatures from 45.7 to 69.4 deg. F. The shortness of the summer season is partly compensated for by the greater length of day and increased sunlight, due to the high latitude.

Precipitation ranges between fifteen and twenty inches annually, and is fairly uniformily distributed throughout the basin. The winter snow in the central portion of the basin lies usually to a depth of about two feet. Though storms and blizzards occur occasionally, their force is broken to some extent by the forests.

Ice in the Athabaska and Peace rivers begins forming any time after the middle of October, breaks up between the middle and the end of April, permitting navigation for five and a half to six months of the year. The season of navigation in the Mackenzie River is about six weeks shorter.

### Geological Characteristics

The pre-Cambrian rocks extend westward to the Slave River and the north arm of the Great Slave Lake and thence northwestward along a series of small lakes to the Great Bear Lake. They form a northward extension of the Laurentian plateau, extending eastward to Hudson Bay, and on the west of the boundary delineated above pass under the stratified rocks. The oldest of the pre-Cambrian rocks consist of metamorphic schists, slates, limestones, quartzites, and volcanic rocks, occurring in isolated areas as erosion remnants. These rocks are intruded by granites and gneissose igneous rocks of various ages. Overlying the former group are younger rocks, not greatly disturbed, consisting of sandstone, conglomerates, shales, limestones, and volcanic rocks, referred to the Keweenawan or Animikie stage of the Algonkian period.

The formations of the Mackenzie and Great Slave basins are, however, prevailingly Devonian, comprising chiefly the middle and upper stages of that period, and resting unconformably upon the pre-Cambrian complex. They consist of a lower dolomitic series, a middle shale series, and an upper limestone series. It is true that Silurian dolomite crops out on Great Slave Lake and in the Franklin Mountains, that Cretaceous sediments overlie the Devonian unconformably at several places along the Mackenzie River, and that Tertiary beds appear near the mouth of the Great Bear River; but the Devonian occupies by far the major part of the area.

Though the Cretaceous contains the oil-bearing horizons of Alberta, to the south, and the well-known tar sands of the Athabaska basin, it is apparently barren of oil in the district of Mackenzie. So far as explored, evidences of oil in the latter area are confined to the Devonian. It is interesting to note that Bosworth suggests the Devonian of Alberta as a possible petroliferous horizon in that province.

The Devonian strata of the district of Mackenzie lie in a great geosyncline, 150 to 500 miles in breadth, between the pre-Cambrian "shield" surrounding Hudson Bay and the metamorphic Paleozoic formation of the flat-lying area characterized, especially near the Rocky Mountains, by a series of anticlinal folds trending northwest-southeast.

### Labor, Food Supplies, and Transportation Lacking

Labor, skilled or unskilled, for the development of the region's resources will have to be brought into the Mackenzie basin from the other provinces of the dominion, or from other countries. The white population of the region is small and consists principally of fur traders, their families, and missionaries. These reside at small trading posts, scattered at intervals of 100 to 200 miles along the valleys of the Slave, Liard, and Mackenzie rivers. The Indians of the Mackenzie basin do not in all probability exceed 6,000 to 7,000 in number.

The region is sparsely populated, and no agricultural settlements are found north of the Peace and Athabaska River valleys. The sparse population of white settlers depends on the food supplies brought in by the steamers of the fur companies to the trading posts. The Indians subsist largely on the products of their hunting and fishing and on the foodstuffs obtained by barter at the trading posts.

The commercial development of the Mackenzie and Great Slave Lake oil fields hinges on the problem of transportation. The discovery well is forty-five miles from the nearest settlement, Fort Norman, and 1,600 miles from the railhead of the Canadian Northern at Fort McMurray, on the Athabaska River. The route from the well to the railroad leads 700 miles by the Mackenzie River to the Great Slave Lake, then up the Athabaska River to Fort McMurray. An alternative route is by the Peace River to the Peace River terminus of the Canadian Northern. These rivers are navigable to steamers of four- or five-foot draft, except for about sixteen miles of rapids on the Slave River near Fort Fitzgerald, where the oil would have to be portaged or locks built, and a similar series of rapids on the Peace River.

The rivers and lakes of the region are frozen during the long winter; navigation is possible for only three to five months of the year. Three steamers, those of the Hudson Bay Company, the Northern Trading Company, and the Lamson-Hubbard Company, ply the river, serving the fur-trading posts, which lie scattered 200 miles or more apart. These steamers run on no regular schedule, but make the journey at the convenience of the owners. Accommodations for either passengers or their freight are slight, as the steamers are generally filled to capacity with their owners' supplies.

An alternative shipping route is by way of Dawson and the Yukon River. A pipe line by the route has been suggested, but numerous topographic difficulties would have to be overcome.

### Mackenzie District

The petroliferous formations of the Mackenzie district may be traced down the valley of the Mackenzie River from its source at the west end of the Great Slave Lake to near the head of its delta. The valley of the river extends for an average width of thirty miles. This area comprises about 24,000 square miles. Not all of the region may be presumed to present the proper structures for oil accumulation. Only a single small area near Fort Norman has been proved by the drill.

The principal indication of the presence of petroleum is the continued outcrop along the river of bituminous shales and limestones from which asphalt exudes. A series of seepages may be traced from a point five miles below Fort Norman to the Ramparts, 100 miles below the fort. Oil springs have been reported near Fort Good Hope, on the right bank of the Peel River, and at a point twenty-three miles below Grand View. The Indians formerly caulked their canoes with pitch obtained from a series of oil springs in the depths of the forest thirty miles east of Fort Simpson at the junction of the Liard and Mackenzie rivers.

Bituminous limestones, gypsum with lenses of bituminous shale, and limestones grading from pure to cherty, sandy and quartzitic, and reddish-weathering sandstones outcropping in the Bear Mountains as they cross the Great Bear River have been referred to the Niagarian stage of the Silurian, though the upper beds may be Helderbergian. Elsewhere, however, the Devonian of the Mackenzie basin rests unconformably on the pre-Cambrian rocks. The lowest member of the recognized Devonian is the Lower Ramparts shale and limestone, consisting of over 300 ft. of hard olive-green bituminous limestones and over 250 ft. of gray-green sandy shales, grading into a shaly limestone above. These are correlated as Oriskany and Onondaga. They are overlain by the Ramparts limestone (Hamilton), a compact gray limestone, definitely bedded in three or four main courses, from 100 to 300 ft. thick.

The Beavertail limestone (Tully) is thin-bedded, hard, dark-colored and bituminous; its thickness varies from 300 to 400 ft. The Beavertail limestone is overlain by 800 to 1,000 ft. of the Hope black bituminous and carbonaceous shales, in alternation with thin beds of limestones, many of which are bituminous. These have been classed with the Genesee-Portage stage. Bluish shales bearing fossils characteristic of the Portage occur along the Mackenzie River, between Fort Providence and Fort Simpson. Characteristic outcrops of the Hope bituminous shales are found at Bear Mountain, just below Great Bear River, along the Grand View River, and for a distance from a point fifteen miles below the Grand View to Old Fort Good Hope. In the last-named area, black, evenly bedded, highly bituminous shales alternate with layers burned red by accidential fires or by spontaneous combustion. It is this shale which gave the largest show of oil in the Fort Norman well. When subject to distillation, two and a half imperial gallons of oil per ton were obtained from this shale.

The uppermost member of the Devonian is the "Norman series," the lower part of which is correlated with the Chemung and the upper part with the Catskill. Its lowest formation is a bluish-green, soft, flaggy sandstone, massive in places, attaining locally a thickness of 300 ft. and in places not appearing. It is overlain by dark-blue plastic shales, 250 ft. thick. A thin-bedded hard argillaceous gray limestone occurs locally, in places attaining a maximum thickness of 50 ft. The Upper Norman shales, 1,200 ft. thick, consist of dark blue, soft, plastic shales with thin sandstone members. The highest formation is the Upper Norman sandstone, 300 ft. thick, which is bluish-green and occurs thin-bedded to massive.

The sandstones of the "Norman series," though rather fine, are soft and porous. They are generally heavily charged with oil. Along one of the creeks several hundred feet of these oil sands were traced in a distance of eighteen miles.

Cretaceous sandstones, fine conglomerates, and coarse shales are visible in places in the Mackenzie valley, unconformably overlying the Devonian. They occur in long stretches along the river below the mouth of the Dahadinni River, along the upper course of the Great Bear River, and around the west and north sides of Great Bear Lake. They outcrop also along the Mackenzie for long stretches between Fort Norman and the Ramparts, below Old Fort Good Hope, and in the basin of the Peel River.

Tertiary sediments occupy a few small areas on the Mackenzie River, notably near the mouth of the Great Bear River, where they cover a basin of about thirty to forty miles in length and twenty to thirty miles wide. They rest uncomformably on both the Cretaceous shales and Devonian limestones. They are of lacustrine origin and consist of cross-bedded sands, sandy clays, clays, and gravels, as well as seams of lignite and carbonaceous shale, attaining a total thickness of 600 ft.

Pleistocene glacial tills, sands, and gravels of varying thickness form the surface deposits of the Mackenzie basin, covering all but the higher mountains. These make the task of tracing the formations difficult, except along the rivers.

### Structure Mainly Horizontal

The Devonian strata of the Mackenzie basin exhibit a remarkable horizontality; they are seldom affected by dips exceeding a few feet to the mile. Shales of the same geologic horizon as those exposed along the Hay River are visible at the Ramparts, 570 miles distant. However, striking breaks in this horizontality occur. At Rock-by-the-River-Side the beds are highly tilted. The disturbances which produced the cordillera threw up the Franklin Range as an anticlinal ridge. In the Mackenzie Mountains the folding has been on a broad scale, which has bent the strata into a series of anticlines and synclines. There is considerable close folding, some of which appears to be overturned and overthrust. The general strike of the beds of these mountains up to 65 deg. N. latitude is slightly west of north; at that point the trend to the northwestward begins. Faulting has occurred at intervals. An example of such faulting is in evidence at Bear Rock, near Fort Norman.

Low anticlines of limited extent occur at intervals all the way to the Upper Ramparts in the Cretaceous, which overlies the Devonian unconformably. The major axes of these anticlines strike north and south. The Tertiary beds near the mouth of the Great Bear River have on the whole an anticlinal attitude, but with low dips.

The main folding of the Devonian took place in pre-Cretaceous times. After the folding, a period of denudation occurred, in which the land surface was carved into a series of mountains and valleys. The Cretaceous was deposited around the mountains by seas and lakes; but the mountains themselves were probably not submerged. Later a slight folding occurred, probably along the old axes, by which the Cretaceous and Tertiary beds attained their present structure.

### Occurrence of Oil

The local geology of the oil field has been described by Dr. T. O. Bosworth.[2] Three hundred feet of black bituminous limestone of Devonian age rests upon 300 ft. of black bituminous shales of the Hope formation. The shales smell strongly of oil, and are undergoing combustion at the outcrops. In some places they are hot to the touch and oxidized to a red color. The bituminous series is overlain by clay-shales and sandstones ("Norman series"). Showing of oil occurs in the sandstones. The strata are folded into long broad anticlines suitable for the accumulation of oil.

### Character of Oil

The petroleum obtained from the Fort Norman well is a dark-green, opaque oil. The first sample drawn showed a specific gravity of 0.8235 (40 deg. Bé). The

[2]Bell, Robert. "The Occurrence of Petroleum in the Northwest Territories"; *Proceedings* Canadian Institute, n.s.; Vol. 1, pp. 225, 230; 1879-1880.

average yield of the well is expected, however, to be nearer 0.8383 specific gravity (37 deg. Bé.). The base of the oil is said to be paraffinic.

The Canadian Department of Mines has made public an official analysis of a sample of crude petroleum of 0.8333 specific gravity (38 deg. Bé.) from the Fort Norman well of the Imperial Oil Co., Ltd. The laboratory test at the University of Alberta showed the following percentages:

ANALYSIS OF FORT NORMAN CRUDE PETROLEUM

| Fractions | Per Cent |
|---|---|
| 70°—150° C. (gasoline) | 23.8 |
| 150°—300° C. (illuminating oil) | 38.2 |
| 300°—350° C. (light lubricating oil) | 33.7 |
| 350°—375° C. (medium lubricating oil) | 4.0 |
| Loss | 0.3 |
| | 100.0 |

In comparison with the lighter oils found in the Okotoks field, southwest of Calgary, Alberta, the Mackenzie sample has a smaller proportion of gasoline. Samples taken from the two districts, however, are much alike with regard to kerosene content.

Oil seeping from the river bed at low water, at a point twenty-five miles below Fort Norman, is reddish-black in color. It flows like engine lubricating oil, burns freely, and gives a strong smell of kerosene.

## History of Exploration

Seepages of oil and asphalt along the shores of the Great Slave Lake and the valley of the Mackenzie River were reported in 1848 by Sir John Richardson in his "Journal of a Boat Voyage." The region was explored in 1875 by Prof. Macoun, of the Canadian Geological Survey, and the indications of oil were observed. The occurrence of petroleum in the Northwest Territories was the subject of a paper by Robert Bell before the Canadian Institute in 1879.

The comparative inaccessibility of the region precluded serious attempts at exploration or development for many years. Active prospecting of the Mackenzie valley began in the spring of 1914, at the time of the boom in the Alberta fields. A party headed by Dr. T. O. Bosworth explored the Mackenzie valley in the interest of a Canadian company (F. C. Lowes, of Calgary, Alberta, and associates), and staked out a number of claims. These claims were acquired by the Imperial Oil Co., Ltd., of Sarnia, Ontario, a subsidiary of the Standard Oil Co. of New Jersey. Drilling by this company began in the spring of 1920 below Fort Norman on the north bank of the Mackenzie River, and was rewarded by the discovery of commercial quantities of petroleum in the Fort Norman well.

## Commercial Development

A camp was established in the fall of 1919 by the Imperial Oil Co., forty-five miles below Fort Norman, where the drilling crew wintered. The test well, located on E. Proctor's claim (Lease No. 1,141) on the delta of Oil Creek, within 200 ft. of the Mackenzie River, was begun in the spring of 1920 with a Star portable drill rig, and a 6-in. casing. It is interesting to note that the strata were found exactly as the geologists had predicted. The formation was principally a shale, easily penetrated. The first showing of oil was met at a depth of 50 ft.; at 80 ft. a yield of two barrels a day was obtained from the Lower Norman sandstone. Increased quantities of oil were found at depths of 187 ft. and 425 ft. Water was encountered only once, at 87 ft. A light flow of gas was obtained. The well came in on Aug. 25, 1920, at a depth of 783 ft., in the crumpled and faulted Hope shales, the oil spouting 15 ft. over the top of the derrick. The well was promptly capped, until arrangements could be made for storage and transportation of the product.

Estimates of the rate of production are various and conflicting. The oil flows intermittently, due apparently to varying pressure. There were no storage tanks in which to measure the oil; the flow was shut off in thirty minutes; and allowance must be made for the customary exaggerations of preliminary press reports. The drillers' estimate of the initial output was 1,500 bbl. a day.

## Great Slave District

The Great Slave Lake district embodies the western and northern shores of that lake, and possibly the south shore, as well as the basin of the Slave River. The Devonian rocks, in which petroleum is expected to occur, begin a little east of the mouth of the Slave River and continue to the west end of the lake. Along the north shore they may be traced eastward as far as the 115 deg. meridian of west longitude.

Pre-Cambrian rocks, in the same sequence as in the Mackenzie valley, outcrop around the eastern half of Great Slave Lake, east of Slave River and of the North Arm of the Lake. An Upper Silurian dolomite crops out for a limited width on the west shore of North Arm, but elsewhere the pre-Cambrian rocks are overlain unconformably by the Devonian. No distinctively Lower Devonian sediments have been observed in the vicinity of the lake shores. The Middle Devonian begins with the thin-bedded, dark bituminous, fine-grained limestones and calcareous shales of Pine Point, and has a thickness of about 100 ft. These are overlain by 200 ft. of Presqu'ile dolomites, exposed at Presqu'ile Point, at Windy Point and around Sulphur Bay, and consisting of a lower, coarsely crystalline, porous and cavernous oil-bearing dolomite, and an upper thin-bedded dolomitic limestone. Overlying the dolomites are the Slave Point limestones, which outcrop between Presqu'ile Point and High Point, on the Buffalo River, and consist of thin-bedded, dark-gray, and slightly bituminous limestones, attaining in places a thickness of 160 ft.

The Simpson shales, which form the lower member of the Upper Devonian on the Mackenzie River, do not appear on the shores of Great Slave Lake, but are believed to underlie the western end of the lake. Paleontological evidence shows that these shales correspond to the Portage formation of New York. The upper member of the Upper Devonian sediments is represented on the shores of the Great Slave Lake by the bluish-green Hay River shales and the overlying thin-bedded, hard, fine-grained, light-colored Hay River limestones. These formations have been correlated with the Chemung of New York.

The Cretaceous is not found on the shores of the Great Slave Lake, but shales of this period overlie unconformably the Devonian formations on the Hay River. The Tertiary is apparently unrepresented.

The entire region is overlain by a heavy deposit of Pleistocene glacial drift. The stream banks show in many places sections 20 to 100 ft. thick of boulder clays and gravels of glacial origin.

The strata of the Great Slave Lake shores are evidently bent in gentle undulations, as far as their structure may be traced beneath a low and swampy

coast. A gentle anticline crosses Great Slave Lake from Pine Point to Windy Point. The anticlinal axis bears about west-northwest. On the south shore the apex of the anticline is shown on the east side of Pine Point; on the north shore the crest appears to lie in the erosion basin of Sulphur Bay.

As the Presqu'ile dolomites are exposed on the limits of the anticline, possibilities of finding oil in commercial quantities on the shores of the lake are not considered by Cameron[3] to be very great. If, however, the dolomite horizon can be found elsewhere in the district under a cover of impervious shales and in a suitable structure, the possibilities may be worth investigating with a drill.

Seepages are numerous at the west end of Great Slave Lake, especially along the north shore. Tar springs occur along the shores of the bay east of Big Island. Oil rises from the bottom of the lake in five feet of water, one and one-half miles offshore. In summer it spreads on the lake until dispersed by a storm. In winter it prevents the ice from forming. At Windy Point (Nintsi Point) oil exudes at the base of a limestone cliff, 100 yards offshore, from cracks in the Presqu'ile dolomitic limestone, floats on the water, gathers in pools, or is absorbed by the spongy moss of the shore. To the north of Windy Point rises a range of hills of Presqu'ile dolomite in which tar springs occur 200 ft. above the level of the lake. Oil springs are found near Fort Rae.

Bituminous shales and limestones occur at several points along the south shore. No seepages are reported.

Petroleum from seepages at Windy Point, on the north shore of Great Slave Lake, is liquid, with a smell of kerosene. It is thick and dark in the surface pools, evidently the residue after evaporation; in the dolomite rock and in the spongy beds of moss it is light yellow and very fluid. A sample of specific gravity 0.949 (17.52 deg. Bé.) analyzed by the Canadian Department of Mines, Mines Branch, gave the following results:

ANALYSES OF CRUDE PETROLEUM FROM WINDY POINT, GREAT SLAVE LAKE

| Fractions | *Ubbelohde Method* Per Cent by Volume | Sp.gr. at 15.5° C. | *Engler Method* Per Cent by Volume | Sp.gr. at 15.5° C. |
|---|---|---|---|---|
| 0°—150° C. (light oils) | 0.9 | ..... | 0.9 | ..... |
| 150°—200° C. (illuminating oils) | 0.2 | ..... | 0.1 | ..... |
| 200°—250° C. (illuminating oils) | 0.1 | ..... | 1.1 | ..... |
| 250°—300° C. (illuminating oils) | 14.2 | 0.871 | 45.9 | 0.863 |
| Residue | 84.6 | 0.956 | 47.2 | 0.983 |
| Loss | 0.0 | ..... | 3.8 | ..... |

The results of both distillations, especially the Engler, were considerably affected by "cracking."

A sample of black, viscous oil with an odor of kerosene was taken from Pointe aux Esclaves (Slave Point), on the north shore of Great Slave Lake. Its specific gravity was 0.957 (16.3 deg. Bé.) at 15.5 deg. C. A preliminary distillation under reduced pressure gave 60 per cent by weight, or 64.5 per cent by volume, of a distillate with a specific gravity of 0.888. This distillate when subjected to a second distillation by the Engler method gave the following analysis:

ANALYSIS OF CRUDE PETROLEUM FROM SLAVE POINT, GREAT SLAVE LAKE

| Fractions | Per Cent by Volume | Specific Gravity | Per Cent by Volume of Original Crude |
|---|---|---|---|
| 0°—178° C. | .. | ..... | .... |
| 178°—300° C. (illuminating oils) | 23 | 0.835 | 14.9 |
| Above 300° C. (lubricants) | 77 | 0.904 | 49.6 |

The oil contained 1 per cent of sulphur. Its calorific value, as tested, was 10,040 kilogram-calories per kilogram (18,070 B.t.u. per lb.).

[3]Cameron, A. E., "Explorations in the Vicinity of Great Slave Lake." Canada Dept. Mines, Geological Survey, Summary Rpt., 1917, pt. C, Ottawa, 1918.

The Imperial Oil Co. began drilling at Windy Point late in the spring of 1920. This well had reached a depth of 400 ft. when the advance of winter prevented further operations. Drilling will be resumed this spring.

The Aurous Gold Mining Co. was said to have a drill rig at Windy Point, with the intention of beginning a well in the spring of 1921.

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Geologic maps of the Mackenzie River and Great Slave Lake basins accompany the papers by Camsell and Malcolm and Willis.

# Technical Papers

**Dictionary of Labor Terms.** — The Harvard Bureau of Business Research, Cambridge, Mass., has issued Bulletin No. 25 entitled "Labor Terminology." Definitions are given of two or three hundred words and phrases used in labor controversy, the aim being to prevent misunderstanding due to ignorance by the employer of the meaning commonly attached to various terms. The list seems to be fairly complete, though we feel sure that had the pamphlet been prepared in Butte, instead of Cambridge, the terms "wobbly" and "rustling card" would have been included.

**Tungsten**—"Tungsten in 1918," a separate of "Mineral Resources," containing fifty-three pages, has been issued and may be obtained on request from the U. S. Geological Survey, Washington, D. C. Domestic production in 1918 amounted to 5,061 tons of concentrates carrying 60 per cent $WO_3$, Colorado being the chief producer. Much information valuable to those in any part of the world who are interested in this metal is given.

**British Guiana** —A "Report on the Lands and Mines Department" for 1919 has been issued by the authority of the Governor and printed by the Argosy Co., Ltd., Government Printers, Georgetown, Demerara. During the year, gold production totaled $287,044.80, and was produced by placer washing and dredging; diamonds, 16,706½ carats; and bauxite, 1,967 tons. In addition, the report covers statements of revenues and expenditures, results of cultivation, grants, forests and forest products, quarries, and statements covering the surveys made by the department. The report is signed by John Mullin, acting commissioner of lands and mines.

**Magnesite** — "Magnesite in 1919," eight pages, may be obtained on request to the U. S. Geological Survey, Washington, D. C. The industry is briefly reviewed, all available statistics are given, and a list of producers is appended.

**Bauxite.**—The *Journal of Indian Industry and Labor* appeared for the first time with the February, 1921, number. It contained a sixteen-page article on bauxite, dealing with its industrial uses, the specifications and standards of quality demanded by buyers, marketing methods, and the sources of supply. (Price, 1 rupee 8 annas, from the Superintendent, Government Printing, India, 8 Hastings St., Calcutta.)

**Powdered Coal**—In *The Iron Age* for April 14 (239 West 39th St., New York, price 50c.) is a brief article by C. F. Herington describing the economies of pulverized coal compared with other fuels for iron furnaces and giving a list of American installations in this field, with capacities and the kind of fuel which the pulverized coal replaced.

**Lead Ores**—The latest monograph published by the Mineral Resources Committee of the Imperial Institute is entitled "Lead Ores." It may be obtained from John Murray, Albemarle St., London, W.1, England, for 6s. The book is paper covered and contains 127 pages. The occurrence, character, and treatment of lead ores are given in the first chapter, followed by two chapters on the world sources of supply of lead ores. Much statistical matter is given, the figures generally including those for 1919. A well-edited little book for those interested in lead.

**Flotation**—"Flotation Tests of Idaho Ores" is the title of a seventy-page bulletin, No. 205, issued by the U. S. Bureau of Mines, Washington, D. C., and obtainable on request. The bulletin describes and gives the results of differential flotation tests on galena-sphalerite ores of various types; on chalcopyrite-pyrrhotite ore; on an antimonial-silver ore; and a copper-gold-silver ore. Lack of data prevented the reaching of any definite conclusions.

**Mackenzie River Oil**—The paper read by John Ness at the Montreal meeting of the Canadian Institute of Mining and Metallurgy is printed in the April *Bulletin* of that Institute. (Drummond Building, Montreal, Que.; price not stated.) It is entitled "The Search for Oil in the West," occupies twenty-eight pages, and is possibly the most complete description of the geology of the prospective oil regions of northwestern Canada yet published.

**Mica**—"Mica in 1919" is now available from the U. S. Geological Survey, Washington, D. C. Besides statistics, the nine-page bulletin discusses the nature and occurrence, physical properties, forms and classification, and uses of this mineral.

**Cement**—Large users of cement who may perchance have thought of making their own will be interested in a detailed article on the cost of making cement, by H. E. Hilts, in the January number of *Public Roads*, published by the Bureau of Public Roads of the U. S. Department of Agriculture. An abstract appears in *Engineering and Contracting* for April 6.

**Wyoming Oil**—Bulletin 702 of the U. S. Geological Survey, Washington, D. C., 107 pages, is entitled "Oil Possibilities in and Around the Baxter Basin, in the Rock Springs Uplift, Sweetwater County, Wyoming." The bulletin may be obtained upon application to the Survey.

**Halides**—"Salt, Bromine and Calcium Chloride in 1919," seventeen pages, can now be obtained on request from the U. S. Geological Survey, Washington, D. C.

**Northern Manitoba** — The Reed-Wekusko Lake area, in northern Manitoba, is described in Memoir 119 of the Canadian Geological Survey, Ottawa, Ont. (437 pages, with maps, free on request.) The geological features and the numerous recently discovered gold-quartz occurrences are discussed.

# Book Reviews

**Financial Engineering.** By O. B. Goldman. Cloth; 6 x 9; pp. 271. John Wiley & Sons, New York. Price, $3.50.

The average technical graduate has to learn at least two things when he begins practical work: one is, that carrying figures out to the fourth or fifth decimal place is not *always* necessary, and the other is the importance of the *cost* of things. This latter point applies not only to the college graduate but to inexperienced technical men in general. Consequently a book on this subject should prove valuable.

The author makes some rather startling statements in the introductory chapter, such as "Competition is industrial disorganization" and "competition is always the short cut to higher costs." Such statements as these, however, are more than offset further on in the book, when the author clears up many what might be called "chronic" misconceptions.

The first five chapters deal with the underlying factors which go to make up the costs with which the engineer must deal. These include such items as depreciation, natural and operating life, fundamental financial calculations, basic costs, and vestances. The latter item furnishes a means whereby differently equipped plants may be compared quite readily on a dollars-and-cents basis.

The prices and operating costs of a large number of different types of machines and equipment are tabulated, due regard being paid to the fractional load characteristics.

The text is well explained by means of numerous concrete examples worked out in detail, and a set of illustrative practice problems is found at the end of some of the chapters for those inclined to make a further study of the subject.

In the later chapters of the book Mr. Goldman resorts to simple integral calculus which at first presents a rather formidable appearance, but which is necessary owing to the number of variables which must be considered. The author admits in his chapter on "The Size of System for Best Financial Efficiency": ". . . the work of solving such cost problems requires skill and considerable painstaking effort; it certainly permits of real and conclusive deductions."

By proper application of the principles developed in this book thousands of dollars might often be saved in the installation and maintenance of even moderately sized plants, and this, after all. is the true test of a book's worth.

Consulting and sales engineers, designers, and factory executives will derive the greatest benefit from this book, although men acting in lesser capacities might well afford to be conversant at least with the principles involved.

T. M. R.

# ECHOES FROM THE FRATERNITY

## SOCIETIES, ADDRESSES, AND REPORTS

### Training for Foreign Exploration Outlined by Director Bain at Rolla, Mo.

The need for practical training in all those professions and avocations essential to the working efficiency of the engineer engaged in exploratory or prospecting work was discussed by Dr. H. Foster Bain, Director of the U. S. Bureau of Mines, before the graduating class of the Missouri School of Mines, at Rolla, Mo., on April 29. The title of the address was "Training for Foreign Exploration," and a summary of its chief points is given here:

"The mining engineer must be versatile," Dr. Bain said.

"To the lore of the geologist he adds the skill of the engineer and the science of the metallurgist. Always and everywhere an eclectic, he adapts means to the end. Clearly, where there are such varied duties and opportunities room for specialization exists, and this is, indeed, the fact. Mining engineers are called on to do geological, mining, and metallurgical work. No one man may be expected to be competent in all three, but one who achieves success in the profession must know something of all."

So long as man exists he will need to practice mining in some form, and as mines are wasting assets the life of the industry depends upon the continual finding of new mines. In fact, the peoples who make the most use of earth materials and forces are the peoples who work the shortest number of hours, produce the most goods, and have the most to divide among themselves. There are great differences between the peoples of various countries and between the countries themselves in this particular.

Thus we may regard the future of the mining profession as fairly assured, but the search for new mines to supply the increasing demands of a swelling population requires knowledge of the widest character. Even a reading knowledge of ancient classics may serve to reveal—as was the actual case with the American copper mine on Cyprus—deposits susceptible of development to meet modern needs. Of course a number of modern languages must be learned, but even these are but a means to the engineer's end, and interpreters should also be relied on. One of the chief values of such knowledge is that it helps to establish friendly relations with the everyday people among whom a modern explorer must work. The geologic facts, however, must be learned at first hand only. For the facts as to character and extent of the deposit one must depend on one's own powers and energy.

As the exploring engineer must "find ore," he must be a well-trained geologist. This is fundamental, but he must go farther and must know in general terms the cost limits which separate "ore" from mere "rock." He must also have an adequate idea of technical difficulties involved, and be able to recognize similar and dissimilar conditions surrounding two or more deposits; so that some apprenticeship under an operating or examining engineer is essential to a geologist who would go into mining or exploration. Costs, labor conditions, labor supply, market, and other questions in economics must be answered also, and training in economics thus become important. The exploring engineer who disregards such problems limits his usefulness and his rewards.

Today, the exploring engineer — and he is the one we are most concerned with—also needs, besides a knowledge of the rules of health, many accomplishments now rarer and classed as old fashioned, but common in the older days of country and village life. It is not always possible to ride up to a prospect in a Pullman or even in a Ford. At times the finding of new mines will take one into countries and circumstances that mean rolling back the centuries and living for a time in the Middle Ages. Skill in what we now call "sports" will always be of great advantage under such surroundings, and on occasion has been known to prove of first importance to an expedition.

"Lastly," said Dr. Bain, "I would urge that to be successful one should have something of the spirit of adventure. Unless new scenes and new faces appeal to you, unless you find joy in the long days in saddle or afoot, unless the cheer of the camp fire means more to you than the clank of the steam radiator, unless to you coffee does not lose its fine flavor when served from a tin cup, unless you can sleep between blankets and not think of their scratching, do not undertake exploration. If you must have a napkin and morning paper at breakfast, if you cannot write save at a well equipped desk, if you are not happy except with your family and intimate friends, if you must see the movies before you can go to bed at night, you will be wise to find a routine job at home."

### Hadfield Offers Prize

Sir Robert Hadfield, of Hadfield's Steel Foundry Co., Ltd., and recipient of the John Fritz medal in 1921, has offered a prize of £154, through the Institution of Mechanical Engineers of Great Britain, for the best design for a device to determine accurately the hardness of metals. The device is to be suited for metallurgical work.

### Idaho School of Mines Offers Fellowships

In co-operation with the U. S. Bureau of Mines and the Idaho Bureau of Mines and Geology the University of Idaho offers in the School of Mines a number of fellowships. These fellowships are open to college graduates who are qualified to undertake research work. The income of each fellowship is $750 a year for the twelve months beginning July 1, 1921.

Fellows will register as students in the University of Idaho and may become candidates for the degree of Master of Science in Mining or Metallurgy. The greater portion of their time will be spent in research work under the direction of the Bureau of Mines staff resident at the university. The purpose of this work is to undertake the solution of definite problems confronting the mining and metallurgical industries of the State of Idaho, such as flotation —with especial reference to differential separation of various minerals; treatment of the complex zinc-lead ores of Idaho; ore-dressing problems, and mining problems.

Applications, with certified copy of collegiate record, statement of professional experience, and names and address of three references, will be received up to June 1, 1921. The applications should be addressed to Francis A. Thomson, dean, School of Mines, Moscow, Idaho.

### A. A. E. Elects Officers

At the annual meeting of the American Association of Engineers, which was held last week at the Hotel Lafayette, Buffalo, N. Y., considerable attention was given the question, How shall technical knowledge be applied in the service of the public? The adequate distribution of engineering ability throughout the country, leading to the better public utilization of engineering knowledge, was also discussed.

At the election of officers H. O. Garman, chief engineer and consultant for the Indiana Public Utilities and Railroad Commissions, was elected president, and A. N. Johnson, at one time with the Calumet & Hecla, later with the Maryland Geological Survey, and now dean of the Engineering College, University of Maryland, was elected vice-president. Among those on the new list of directors is Prof. G. M. Butler, dean of the Department of Mines and Engineering, University of Arizona, and director of the Arizona Bureau of Mines.

The association is steadily growing in membership, and is doing much to improve the working conditions of the younger engineers of this country.

## MEN YOU SHOULD KNOW ABOUT

**Frederick M. Feiker,** vice-president and chairman of the Editorial Board of the McGraw-Hill Co., has been selected by Herbert Hoover, Secretary of Commerce, as his personal assistant in his plans to organize and develop the bureaus of Foreign and Domestic Commerce, of Standards, and of the Census, as aids to business. Mr. Feiker's wide experience and extensive acquaintance in technical journalism and in the general industrial field should be of great service in the solution of those industrial problems now pressing for attention.

FREDERICK M. FEIKER

By a series of conferences with the representative men of industry, the Government will learn what kinds of facts and figures industry needs. Having organized the department to meet these requirements, the next problem will be to devise an adequate system for clearing the collected data back to business. Mr. Feiker's training, grasp of the needs of industry, and sense of publicity qualify him in a marked degree to render unusual service in furthering Secretary Hoover's plans to make the Department of Commerce an aid to industry and business.

Mr. Feiker is an electrical engineer by profession and has been specially interested in aiding Mr. Hoover in the development of his plan for the elimination of waste in industry which was undertaken by the Federated American Engineering Societies at Mr. Hoover's suggestion. He is a graduate of the Worcester, Mass., Polytechnic Institute, class of 1904. Following graduation, Mr. Feiker assisted in special research work in high-tension transmission and generation at Worcester. From 1906 to 1907 he served the General Electric Co., Schenectady, N. Y., as technical journalist, and in the latter year went with the *System* magazine at Chicago, Ill., soon after developing the idea of *Factory* magazine, of which he became managing editor. From 1912 to 1915 he was chairman of the editorial board of the A. W. Shaw publications, of Chicago. In the latter year he joined the McGraw organization as editor of *Electrical World,* which he soon supplemented by assuming like duties on *Electrical Merchandising.* In 1920 he was made a vice-president and chairman of the Board of Editors of the McGraw-Hill Co. He has been one of the prime movers in the movement to interest engineers in the broad problems of public service. While in Government service Mr. Feiker will retain his status with the McGraw-Hill Co.

**R. R. Rose,** mining engineer of Montreal, and acting secretary of the Canadian Institute of Mining and Metallurgy from October, 1919, to January, 1921, has accepted a professional position with the Hollinger Consolidated Coal Mines, Ltd., at Timmins, Ont.

**Theodore A. Link,** geologist with the geological department of Imperial Oil, Ltd., has left Edmonton, Alta, for the Fort Norman field, in Mackenzie River district. He will make the trip by airplane.

**Myron R. Walker,** mine superintendent for the Corporación Minera Famatina, Chilecito, Argentina, stopped in New York City on May 11, while en route to his home in Pittsburgh, Pa.

**Mining and metallurgical engineers recently visiting New York City** included: **H. A. Kee,** of Kerr Lake Mining Co., Cobalt, Ont.; **Myron R. Walker,** Pittsburgh, Pa.; **Chas. F. Haselton.** West Hartford, Conn.; **Herbert H. Lauer,** Allentown, Pa.; **Gardner F. Williams,** San Francisco, Cal.; **Harvey A. Mudd,** Los Angeles, Cal.; **LeRoy B. Mitchell,** Bisbee, Ariz.; **B. L. Miller, Bethlehem,** Pa.; **Graham John Mitchell,** Bisbee, Ariz.

## SOCIETY MEETINGS ANNOUNCED

**American Institute of Mining and Metallurgical Engineers** will hold its annual meeting at Wilkes-Barre, Pa., during the week beginning Sept. 12, next.

## OBITUARY

**Franklin K. Lane,** Secretary of the Interior Department under Woodrow Wilson, died of heart disease on May 18.

**M. E. Wadsworth,** geologist, mining engineer, and educator, died at his home in Pittsburgh, Pa., on April 21, in his seventy-fourth year. Dr. Wadsworth was dean emeritus of the School of Mines of Pennsylvania State College, a school of which he was in charge from 1901 until his retirement on the Carnegie Foundation in July, 1912. His greatest service, perhaps, was the organization and development of the Michigan College of Mines, of which he was president from 1887 to 1899. Prior to the call to that work Dr. Wadsworth had done much valuable research, having served as geologist on the state surveys of New Hampshire and Minnesota, remodeled the geologic instruction at Colby, and introduced under J. D. Whitney at Harvard the microscopical petrography which he had studied under young Rosenbusch, Michel-Levy, and others in Europe. Professor Wadsworth was among other things one of the firm supporters of the theory of the igneous origin of iron ores. He was born at Livermore Falls, Me., on May 6, 1847, and held degrees, in course, from Bowdoin and Harvard colleges and the University of Heidelberg. Many honorary degrees were conferred on him and many societies claimed him as a member, notably the Geological Society and the Mining and Metallurgical Society of America.

# THE MINING NEWS

## LEADING EVENTS

### Principals in Apex Suit Differ Over Accounting Details

**Utah Apex To File Exceptions to Statement Submitted by Utah Consolidated**

It is stated that the Utah Apex Mining Co. will file exceptions to the accounting for damages submitted by the Utah Consolidated Mining Co. in accordance with the court's decree, to make good the illegal extraction of ore from Utah Apex ground. Both properties are at Bingham Canyon, Utah. The Utah Consolidated has filed the following account in the circuit court of Utah:

| | Principal | Interest | Total |
|---|---|---|---|
| 1917 | $ 47,573 | $10,731 | $58,304 |
| 1918 | 159,267 | 23,213 | 182,481 |
| 1919 | 208,111 | 13,646 | 221 758 |
| 1920 | 196,437 | .... | 196,437 |
| | | | $658,986 |

The Utah Apex has taken exception to the accounting, claiming that the sum of $655,986 is insufficient. The damages claimed by the Utah Apex amounted to $2,500,000. It is said that if the exceptions claimed by the Utah Apex be allowed, the total sum to be paid will more nearly approach the latter amount than the sum agreed to by the Consolidated. The Utah Apex is having the Utah Consolidated books audited by accountants. After the filing of the exceptions will come the adjudicating of the difference, and the settlement of the case, unless, of course, the Utah Consolidated should take an appeal. The Utah Apex is closed down at present, owing to the low price of lead, but it is probable that the recent rise in the price of that metal, if continued, will bring about the reopening of this large producer.

### Jerome Verde Holdings Now Under U. V. Extension Control

At a meeting in Phoenix, Ariz., on May 5, with 72 per cent of the 5,230,000 shares represented, sale of the property of the Jerome Verde Copper Co. to the Jerome Verde Development Co. was agreed upon. New stock is to be accepted at the rate of one share for ten of the old. The new corporation will be controlled by the United Verde Extension Co., which, on approval of 75 per cent of the old stockholders, will proceed upon expenditure of $420,000 in development work and payment of debts. The acreage thus acquired is one of the largest mining plots in the district, lying west and northwest of the Extension, north of some separated Extension claims and east of the main property of the United Verde. Through the consolidation, Dundee, with its two claims will be wholly in Extension territory.

WEEKLY RÉSUMÉ

*From Washington it is reported that Secretary Fall is against liberalizing existing legislation for war minerals relief. It is stated that a new commission may be appointed. The proposed revision of the mining code, which the Ingalls committee has been considering, is now ready for Congress. Numerous protests against further suspension of assessment work requirements have been received.*

*In northern Michigan, the Seneca Copper Corporation has purchased the interest held by the Hancock Consolidated Mining Co. in the Lake Milling, Smelting & Refining Co., thus acquiring sufficient milling capacity for its needs. In Arizona, the holdings of the Jerome-Verde Copper Co. have passed under the control of the United Verde Extension company. In New Mexico, the state tax commission has acquired the services of J. R. Finlay for the work of appraising the value of mines within the state. In Utah, the Utah Apex Mining Co. is expected to file exceptions to the accounting made by Utah Consolidated as the outcome of the apex suit won by the former. The Interstate Commerce Commission has set May 31 as the date for its hearing, at Chicago, on iron ore freight rates in the Lake Superior district.*

### J. R. Finlay To Appraise Mines of New Mexico

The State Tax Commission of New Mexico has entered into contract with J. R. Finlay, of New York, to appraise the mines of New Mexico for taxation purposes as he did the mines of Michigan in 1911, the work of appraisal to begin by Sept. 1 next, and to be completed by Feb. 1, 1922. This mine evaluation is in accordance with a law passed by the State Legislature in February this year.

### Hearing on Iron Ore Freight Rates at Chicago, May 31

A hearing has been announced by the Interstate Commerce Commission, to be held in Chicago May 31, on the complaint of the Lake Superior Iron Ore Association relative to the freight rates on iron ore in Michigan, Minnesota, and Wisconsin. The eighty-seven members of the association who have signed the complaint have petitioned the commission to fix such rates for the defendant carriers, from June 25, 1918, to the present, so that the returns from their investment will yield 6 per cent. Owing to the scope of such a complaint, it is expected that it will take considerable time to hear all evidence.

### Situation of Potash Industry in Germany Changed

**Various Schemes for Socialization Contemplated—Position of Kali Syndicate Weakened**

*From Our Berlin Correspondent*

**Berlin, April 15**—The end of the war found the German potash industry in a position quite different from that which it occupied in pre-war times. The fact that numerous countries are now producing potassium by chemical process, the finds in Spain and mainly the loss of Alsace-Lorraine have made a wide breach into the monopoly Germany had been enjoying throughout the whole world as potassium producer. The privileged position of the all-powerful German Potassium Syndicate is considerably weakened. This syndicate now finds it hard to market the industry's output, even at the present reduced scale. Export, which was fairly brisk last year, has greatly diminished. Exports of potassium salts in 1920 reached almost 60 per cent of the shipments of 1913, but have in the course of the current year dwindled down at an alarming rate. The domestic market also consumes not nearly the same quantity of potassium products as in pre-war times. Prices had to be lowered along the whole line, in order to stimulate the sluggish demand and to meet the foreign competition, especially that of the Alsace-Lorraine producers. The result is that only the richest and best-equipped mines are working on a paying basis, while the poor ones are operating at a loss.

The following are the present prices of potassium products at the mines:

| | Per cent of Pure Potassium | Price per Metric Ton, Marks |
|---|---|---|
| Carnallite | 9 | 45 |
| Kainit | 12 | 72 |
| Kainit | 15 | 90 |
| Fertilizer salts | 20 | 148 |
| Fertilizer salts | 30 | 249 |
| Fertilizer salts | 40 | 388 |
| Fertilizer salts | 42 | 407 |
| Chloride of potassium | 50 | 575 |
| Potassium sulphate | 48 | 729 |
| Potassium magnesium sulphate | 26 | 434 |

The recent increase of the railroad rates is further aggravating the already rather precarious situation. This increase, which is 50 to 60 per cent, will increase the cost to purchasers, according to distance, up to 160 per cent. This is bound to react strongly on the demand, especially in the agricultural districts in the Northeast, as previous increases of price indicate. The cost of transportation from Stassfurt to Königsberg in eastern Prussia of a 15-ton truckload of kainit, for instance,

which used to be 110 marks in 1914, is 1,600 marks since April 1, considerably exceeding the price of the product itself, which is only 1,000 marks to 1,350 marks, according to grade.

In this situation the Kali Syndicate has decided upon a remarkable policy. It is evidently concluded that the demand will, if not at once, gradually decrease to a certain minimum of rock bottom necessity, which can be assumed to remain stationary regardless of prices. This seems to be the only explanation for the decision to follow the rise of transportation rates by a rise of prices, which, according to the proposal of the syndicate, will be no less than 65 per cent. It is obviously argued that the business which will be left shall at least be profitable. This proposed rise of potassium prices is, therefore, a radical measure which appears to be chiefly made in the interest of the weaker members of the syndicate.

This situation has the fullest attention of the government, or the administrative body, the National Kali Council, which as in the case of the coal production, has been constituted to exercise control over the potassium industry. The intention of the Kali Syndicate—to protect the poor mines—is not supported by this body. On the contrary, the prevailing tendency is to shut down the unprofitable mines in the interest of economy. Such strong measures are considered unavoidable. This tendency finds marked expression in the various proposals which have lately been forthcoming for the socialization of this industry.

It will be remembered that the coal and the potassium industry have been singled out to make a start with in the matter of socialization, and the government is being urged to proceed with it. Although the problem of socialization of the coal industry, which for a time toward the end of last year had assumed an acute aspect, has since then been pigeonholed, evidently for an indefinite time, the socialization of the potassium industry might possibly take concrete shape. the opposition of the mine owners being not nearly so strong as that of the coal producers.

### Three Schemes for Socialization

The committee constituted for socialization problems has now three schemes under consideration. The first of these, submitted by industrial leaders like Rathenau and Siemens, has nothing to do with socialization proper, but attempts to put the industry on a sound basis by higher economy and co-operation. This scheme is identical to a large degree with the notions of the National Kali Council. Its main points are to effect the apportioning of production, which by the present legislation is adjusted at intervals of five years, by adjustments of longer duration, at least of thirty years. Mines going out of operation shall be permitted to sell their portion to other mines. Sinking of new shafts shall be prohibited by law. The National Kali Council shall further be empowered to enforce the shutting down of such works which during several years have been on an unprofitable basis. It is hoped that such measures will to a large degree tend to induce mine owners to shut down voluntarily. The authors of this proposal are, however, emphasizing that a contraction of the production cannot be delayed any longer, and that, if poor mines should not decide to shut down within a reasonable time, compulsory measures should be adopted. These proposals are supported by the non-socialistic trade unions.

The representatives of the socialistic unions, however, submitted a scheme, which in a much more pronounced way conforms with the socialization theories. They propose to form two organizations, one for the operation of the mines, the other for the selling of their products, both to be controlled by the National Kali Council. The latter shall be composed of representatives of the employed and the employers, geological and chemical scientists, and agricultural and chemical consumers. The executive is to be placed with a body of the directors of the five largest mining districts. The operating organization shall issue shares, nine-twentieths of which will be used for indemnifying the mine owners, while eleven-twentieths remain in the possession of the organization. The mine owners shall be entitled to a preferential dividend of 4 per cent, while the rest of the profits is divided equally between all shares. Premiums shall be paid for the reduction of working cost, in order to stimulate engineers and workmen to higher productivity and economy. The selling organization shall receive a monopoly, confirmed by legislation.

The author of the third scheme is Professor Lederer, who has also been responsible for one of the main proposals applying to the socialization of the coal mines. He proposes the formation of a holding company, organized as a joint stock company, the "Kali Trust." Part of the shares of this trust shall be issued to the mine owners, the private owners as well as the states, in proportion to their valuated assets. The rest shall remain state property. While, however, the socialistic proposal would give the state a controlling share Professor Lederer's scheme apportions the trust shares in such a way that the mine owners hold 51 per cent and the state 49 per cent. The National Kali Council shall be given a decisive voice in the management of the trust. The adjustment of prices shall as hitherto be subject to the approval of this council, and it shall be empowered to take any measures it may think fit for the reduction or the increase of production.

At present it is difficult to see on what lines the socialization committee will proceed, but from all indications it can be taken that the socialistic scheme has very little chance of realization. It is most likely that, as in the case of the coal socialization, a policy of procrastination will be followed.

## Silver Mines in Arkansas To Be Developed

### Hot Springs Business Men Organize $50,000 Company To Reopen Old Mines in Montgomery County

Interest is being taken in Hot Springs, Ark., in the reopening of the old silver mines near Silver, Montgomery County, about thirty miles west of Hot Springs. The Silver King Mining Co. was recently incorporated by J. W. Kelly and other Hot Springs business men, with a capital of $50,000. The company has purchased the old Waterloo mine in fee and has leased about 1,300 acres in the immediate vicinity of the Waterloo, including the Elnora, Silver City, Minnesota, and other mines, and containing all the known veins in the district.

Boilers, a compressor, drills, a hoist and other machinery have been purchased and installed. The Waterloo shaft has been unwatered and sinking is in progress. The old shaft now 185 ft. deep, will be sunk an additional 350 ft., and drifting will be done on the vein at the bottom level, with the idea of proving the vein.

The district around Silver is an old one, mining having been done there in the early 80's by crude methods and under poor operating conditions. Some of the properties gave large returns even at that time, and Silver was a properous and booming mining camp, with stores, banks, and more than 1,500 inhabitants. No work has been done for nearly forty years, since the properties were closed, due to poor mining, unfavorable operating conditions, and the forty-mile haul to the railroad.

The ore occurs in veins which cut across the steeply dipping shales and slates at an opposite angle. The filling is quartz and calcite. The silver-bearing minerals are galena, sphalerite, and tetrahedrite. The assays as given by Dr. Branner in the Arkansas state geological report are high, ranging from 21 to 446 oz. of silver per ton. The present operators plan an initial expenditure of about $25,000 for sinking and drifting with the idea of proving up the property at depth.

## Clement K. Quinn Takes Option on Atikokan Iron Mine

Contrary to recent press statements Clement K. Quinn has not purchased the Atikokan iron mine, in Ontario, but has simply taken an option on it with the idea of carrying on further investigations. The Atikokan mine is located about 125 miles west of Port Arthur in Ontario and on the main line of the Canadian Northern Ry. between Port Arthur and Winnipeg. The McKenzie-Mann interests and the Stamford White interests, of Chicago, have controlled this property for a number of years through the Atikokan Iron Co., and at one time operated a blast furnace in Port Arthur which was run exclusively on these ores. The tonnage developed is quite large. Mr. Quinn has been identified with the property in one way or another for several years.

### To Encourage Shipment of Iron Ore Stockpiles

The Great Northern and the Duluth, Missabe & Northern railroads have notified the mining companies on the Mesabi Range that the charge of $7.50 per hour for the use of switch engines and crews in spotting cars for loading stockpiles has been eliminated. This means a saving of 2½ to 3c. a ton in handling ore in stockpiles. It is anticipated that it will encourage the shipping of some of the stockpiles to the steel furnaces.

### Volatilization Process Giving Satisfaction in Test Runs at Salt Lake City

Test runs of twenty-four hours' duration or longer, which are being made in the volatilization plant of the U. S. Bureau of Mines at the University of Utah, are bringing satisfactory results. The plant at the university is semi-commercial and is said to prove that the volatilization process can be applied on a commercial scale to low-grade oxidized and semi-oxidized ores, which do not respond to flotation or other processes. A good recovery is being made, at moderate cost. There are large deposits of ores of the nature described in the West, carrying 5 to 6 per cent lead and about 5 oz. in silver, which do not respond to flotation or other processes. The process will be especially useful where the deposits are far from the railroad, as the bullion only need be shipped.

Volatilization plants can be erected at comparatively low cost, as the construction is simple. The installation of electrical appliances used in connection with such plants would probably be the heaviest item of expense, but this would not be prohibitive. Power costs would be reasonable, for although the voltage would be high, the amperage would be proportionately low.

In preparation for treatment by volatilization, the ore is crushed to different sizes, varying from four to thirty mesh. The crushed rock is then mixed with sodium chloride, or common table salt, and this mixture fed into a revolving kiln, where it is roasted. By this roasting is formed chlorine gas, which picks up the metal values in the form of chlorides. These chlorides are collected and run off to a Cottrell precipitator, which consists of a number of air-tight pipes, through the center of which runs a nichrome wire. A high voltage of practically static electricity is discharged from this wire, which causes the solid particles to be dropped. These particles or fumes, resembling ashes in appearance, are smelted into bullion. Experiments made in the reduction of fumes in several types of furnaces—including electric, blast, reverberatory, or muffle—have proved that a high extraction can be made. Thomas A. Varley is in charge of the work at the Utah station.

### Ontario Mining Act Changed

Legislation passed by the Ontario Legislature makes some changes in the Mining Act. The most important of these relieves patented mining claims from sudden forfeiture for the non-payment of acreage taxes. Last fall a large number of claims were declared forfeited and thrown open for re-staking, the owners of which having, for the most part, inadvertently, failed to pay the small amount of the tax. A years' grace is now allowed, during which patentees can redeem their claims. Another amendment reduces the amount of assessment work required from 240 to 200 days, spread over five years, forty days to be worked each year.

# NEWS FROM WASHINGTON

By PAUL WOOTON
Special Correspondent

### Fall Against Liberalizing Act For War Minerals Relief

**Possible That Present Law May Be Construed More Freely—Appointment of New Commission Expected**

The Secretary of the Interior is opposed to legislation at this time which will liberalize the War Minerals Relief Act. Before any legislation is attempted he wants to assure himself that more liberal treatment cannot be accorded claimants under the existing statute. A new war minerals relief commission is to be named in the near future, it is understood. Secretary Fall will not be surprised if a new commission will find it possible to construe the law more liberally than the present commission.

The objection to the bill, which would widen the scope of the existing law by admitting stimulation based on a published notice, is that it would open the door for manufacturing and all types of war activities which were stimulated by published notices of the Government's needs. The passage of the War Minerals Relief Act was made possible because it was declared that the Government had practically entered into a contract with certain producers of war minerals. After certain producers had been urged personally by officials of the Government to produce certain war minerals Congress accepted a policy of moral responsibility in certain cases where negotiations had not reached the stage of an actual contract. There will be determined opposition to any expansion of the law which will bring into such a classification those who had nothing more formal than a published article on which to base their assertion of stimulation.

### Proposed Mining Code Revision Ready for Congress

**Changes Prepared by Ingalls Committee To Be Submitted Soon to Committees on Mines**

The text of the proposed revision of the mining code will be submitted to Congress within a few days, the Bureau of Mines has advised the committees on Mines and Mining of the Senate and of the House of Representatives. This is the fourth revision of the law, and represents extended and painstaking work on the part of the committee, consisting of W. R. Ingalls, J. Parke Channing, Horace V. Winchell, L. D. Ricketts, and Walter Douglas.

Both Senator Poindexter and Representative Rhodes, chairmen respectively of the committees of Mines and Mining of the Senate and the House, are particularly anxious to take up the consideration of this revision. It is generally admitted that the present mining code, adopted in 1872, is in urgent need of revision.

### Many Demand Assessment Work Be Resumed

**Alaskan Delegate Against Fiscal Year Basis for Far North**

Senator Poindexter, the chairman of the Senate Committee on Mines and Mining, is receiving a large number of letters protesting against any further exemptions from assessment work on mining claims. These letters come from all the states affected, and indicate, Senator Poindexter said, a widespread demand for the resumption of assessment work.

The delegate from Alaska has filed a formal protest with the Senate and House committees against any change in the assessment work year in Alaska. He says most of the assessment work there is done in the winter when the snow facilitates traveling. In view of his protest a proviso will be added to the bill changing assessment work to a fiscal year basis, which will exempt Alaska from that change and specify that the assessment work there is to be completed on or before Dec. 31.

### Shipping Strike Holds Up Alaska Sailings

The marine strike has tied up boats in the Alaskan service, and as a result the geological and topographical parties assigned to do work for the U. S. Geological Survey in Alaska have been delayed in leaving Seattle.

# NEWS BY MINING DISTRICTS

## Special London Letter

### Ivanhoe Company in Australia Affected by High Labor Cost; Financial Position Sound—Rand Working Costs About £5 Per Oz.—Nigerian Tin Royalties Modified

BY W. A. DOMAN

**London, May 3**—In the same manner as the South African mines the West Australian gold companies are becoming more and more dependent upon the excess realized for the metal above the standard price. The Ivanhoe, one of the greatest of the Kalgoorlie mines, is feeling severely the high level of working expenditure due to advances in wages and reductions in hours of labor—to say nothing of the additional outlays caused by the frequent strikes. At the time of writing a woodcutters' strike is in progress, and is affecting not the Ivanhoe alone but various other properties.

In 1919 working costs averaged 31/6 per ton, which meant that the averages of the reserves could be made to yield a profit only by the incidence of the gold premium. Last year the cost was 32/6 per ton, and during the current period it is likely to be higher still. At the beginning of 1920 the ore reserves were estimated at 972,387 tons, worth 33/9 per ton; at the end of the year they were 861,786 tons, averaging 34/4 per ton. Taking residues at about 4/2 per ton the recovery would be approximately 30/—, showing a loss of 2/6 a ton, to be made good by the gold premium. About one-third of the total tonnage could be extracted at a profit at the standard price of the metal. As 154,920 tons was milled last year only about 44,000 tons of new ore was opened up.

The company writes off all development charges against working costs. To the end of last year the sum laid out on development and equipment was £1,134,900, and this stands in the balance sheet at only £54,295, the original working capital of the company. As a result, the financial position is quite sound. The Ivanhoe seems to be an investment as well as a mining company, for it has £126,797 in thirty-one different securities, this being equal to 12.6 per cent of the capital. On account of last year 6/6 per £5 share was paid in dividends, making a total since the inception of the company of £3,885,000, or 38.8 per cent of the value of the gold recovered from the treatment of 4,202,445 tons of ore.

The Nourse Mines works two reefs, the Main Reef Leader and the South Reef, the former being the principal gold carrier. Values show a tendency to improve.

The decrease in the reef width last quarter is more than compensated for by the gold content, for, as worked out on the Rand, the number of inch-dwt. is 480, as compared with 425. The Nourse Mines has been doing none too well, so that the improvement shown in the six months is welcome.

Generally speaking it would appear that the average working costs of the mines of the Rand are now approximately £5 per oz. As the realizable value is only slightly over this figure it is clear that several of the properties will soon be under the necessity of closing down unless the price of gold recovers or the level of working expenses can be reduced. Naturally the bulk of the community does not wish to see the price of gold rise, because it means a further depreciation in the paper money in circulation. A decline in costs is probable, but whether it will go so far as to compensate for the fall in the price of gold remains to be seen.

Last week I mentioned that the Nigerian government was taking steps to alleviate the burdens of the tin-mining industry. So far, railway rates have not been reduced; only the scale of royalties has undergone modification. On the old scale, when tin was quoted below £130, 2 per cent was paid on value, the figure rising until on £180 and upward it was 7½ per cent. Now the rate is 2 per cent when the price is less than £180, and rises by easy stages until it reaches 10 per cent on £300 and upward.

## CANADA

### British Columbia

### Premier Aërial Tramway To Be 11½ Miles Long

**Stewart**—The Red Cliff group of mineral claims on Bear River is reported to have been taken over by Messrs. R. W. Wood and A. B. Trites, who propose developing them this year. The outcrop on the Montrose claim is said to contain good gold values, with a small percentage of copper and a greater one of iron pyrites.

P. H. Graham, who has charge of the installation of an 11½-mile aërial tramway for the Premier mining company, from that company's property at Salmon River to tidewater near Stewart, has taken personal direction of the work. The tramway, the route of which parallels the wagon road, will require enough lumber to keep the Hyder and Stewart mills busy for some months. There are to be 150 ordinary towers and twelve tension towers, as well as three angle stations and two terminals. The stationary or carrying cable will be of one-inch steel and the traveling cable five-eighths of an inch in diameter. Mr. Graham also is to supervise the construction of ore bunkers at the wharf, at Stewart, the same having a capacity of 4,000 tons.

**Hudson's Hope** — The provincial government has let a contract to Lynch Brothers, of Vancouver, B. C., to sink three test holes by diamond drill in the Boulder Creek district, about 24 miles northeast of Hudson's Hope. A minimum of about 3,000 ft. of drilling is to be done. The party already has set out for the locality and expects to begin work soon. This action is in line with the policy of the government of definitely ascertaining the oil possibilities of the Peace River country.

R. D. Featherstonehaugh plans to prospect the placer gravels of the Ingenika River, in the Peace River district, this year on a considerable scale for gold and platinum. He will be assisted by William Halderman. The company's claims are not far from Hudson's Hope. They will be worked by drag-line scraper, scraper capacity being 1,000 cu.yd. of gravel daily. Operations will continue until about the middle of October.

**Trail**—Ore shipments received at the Consolidated smelter the week ended May 7 totaled 9,583 tons, coming entirely from the company's mines.

**New Denver**—The Slocan Lake Union No. 98, Internation Union of Mine, Mill and Smelter Workers, has accepted a proposition providing for a reduction of 75c. per shift in all classes of labor, as previously more briefly announced. Rates for board have been reduced by the operators from $1.50 to $1.25 per day. The recognized wage scale throughout the Slocan will stand for the present for the various classes of labor: Miners, $4.50; muckers, $4; timbermen, $5; timbermen's helpers, $4.50; millmen, $5; flotation men, $4.50; carpenters, $5.50; blacksmiths, $5; blacksmith's helpers, $4.50; steam compressormen, $5; compressormen other than steam, $4.50; head end tramway operators, $4.50; underground mule drivers, $4.50; mule train brakemen, $4; teamsters, $5; cable men, $4.50; unskilled, $4. These scales became effective on May 6 but are subject to revision at quarterly conferences.

**Sandon** — Officials of Silversmith Mines, Ltd., which company closed arrangements for the purchase of the Ivanhoe mill of the Minnesota Silver Co. early in May, have announced plans for amalgamation of the present Silversmith milling equipment with the Ivanhoe plant. The building housing the latter will be enlarged. The change will give Silversmith a daily milling capacity of from 150 to 300 tons. A few men are at work on the preliminary operations, and by the end of the summer it is expected that the Silversmith mill equipment will be moved down to the Ivanhoe mill site, construction completed and the combined plant in operation. Use of the present half-

mile Silversmith aërial tram to Sandon will be discontinued and an entirely new tramway, about a mile long, built from the Silversmith main adit tunnel to the Ivanhoe mill site, which is about a mile below Sandon. Underground development at the Silversmith has been entirely discontinued for the present, as ample ore reserves are available.

### The Cariboo District

#### Rich Shallow Ground Exhausted, but Other Areas Offer Promise—Government's Attitude Changed Toward Speculators

BY DONALD D. FRASER

Official figures give the placer gold production of the Cariboo district of British Columbia as $45,000,000, although the actual production is variously estimated at between $60,000,000 and $75,000,000. For twenty years after its discovery it was a prolific gold producer. Since that time its output has gradually diminished until in 1919 the district is officially credited with less than $80,000.

The gold fields of the Cariboo cover an extensive area, about 7,000 sq.mi. The eastern boundary is the Cariboo Range and the western the Fraser River. From the Horsefly River on the south it reaches well northward toward the Grand Trunk Pacific R.R. The eastern section is mountainous, with peaks rising to 8,000 ft. Proceeding westward the topography becomes more subdued and merges into a plateau which slopes to the Fraser and Quesnel rivers. There are three main rivers which drain this territory, the Willow, the Cottonwood, and the Quesnel. It is mainly along the headwaters of these rivers that the gold has been recovered, although the headwaters of Bear River were also important producers. The direction of the glacial action has apparently been from northeast to southwest. The glacial debris gradually increases in this direction. The country rock is composed of various slates and schists, which are cut by numerous quartz veins. These veins were undoubtedly the source of most of the placer gold discovered.

There were three main sections of the district which produced the major portion of the gold; namely, Barkerville, Stanley, and Keithley, in order of their importance. The character of the ground worked comes under two main headings: the shallow ground of the creeks and benches and the deep ground of the main drainage basins. Both glacial and pre-glacial deposits occur. These areas were extremely rich and soon worked out. Drifting, ground sluicing, rocking all played a part. It will be noted that these three centers are near the head of the district, the country sloping in all directions from them. As the rich shallow ground became exhausted attempts were made further down the drainage systems. Most of these failed when it was not possible to combat the underground water and heavy ground. Hydraulicking has found wide application but mainly around the three centers named. In both drifting and hydraulicking there have probably been as many cases of "mining the public" as of mining the ground. Hydraulicking has, however, been successful where used with good judgment and good management. Except for a few half-hearted attempts on the Quesnel River dredging has not been attempted. This is owing mainly to the high transportation rates which have prevailed in the past.

The main cause for the lessened production is the exhaustion of the rich shallow ground. The cream has evidently been skimmed. A further cause, which is by no means a small one, is the attitude of capital due to the extensive wildcatting and bad management of the past. Added to these have been the high freight rates and the consequent excessive costs. Last but by no means least is the fact that so much of the country has been tied up by speculators.

Regarding this last point the attitude of the provincial government has not aided the development of the placer ground of the province. By far the larger part of the ground taken up is under leases, of which there are two kinds; namely, a creek lease and a bench lease. A creek lease is one-half mile long and the width of the valley. A bench lease has a 1,500-ft. creek frontage with an area of 80 acres. Each lease represents a fairly large tract of land. It has been customary to grant these leases for a term of twenty years. The lessee obligated himself to perform $1,000 worth of work annually and pay a yearly rental of $75 and $50 for a creek and bench lease, respectively. These terms were found to be impracticable, and so, instead of correcting them, the government did not attempt to hold the lessee to them. The consequence was that by paying the first year's rental anyone could obtain a twenty-year lease on crown land and hold it for speculation without doing any work or paying further rentals. That is what happened. Practically all the ground within easy reach has been held in this manner. In many cases the ground was held for high figures and capital went elsewhere. Last year, however, this matter was remedied. The rentals have been lowered to $37.50 for a creek lease and $25 for a bench lease. The work required has been cut to $250 per year. In case the lessee does not meet these requirements his lease is cancelled.

The new government railroad, the Pacific Great Eastern, is now being extended through the district, so that the communication will be direct to Vancouver. Freight delays and rates should be greatly lessened.

The district is by no means exhausted. About the above-named centers there are numerous creeks and benches well worth investigating. The areas remaining are buried deep under glacial debris and need intelligent prospecting before large expenditures are made. The ground may be drilled to good advantage. Toward the head of the district the water supply is small, but the richness of the ground makes up for this deficiency. There are large areas on Williams, Antler, Beaver Pass, Swift, Swamp and other creeks which are worth investigating for dredging purposes. Slough, Peters, Fountaine, Lower Lightning and other creeks hold good possibilities for deep drifting if the water can be handled successfully. There are innumerable creeks and benches which offer a variety for the investor looking for hydraulicking ground.

As soon as capital looks favorably again upon gold mining there will probably be renewed activity in all three of these fields. The district is not unique in that new companies seem to think that all that is necessary in a placer camp is to find a spot where there is some evidence of gold and then decide upon a method of operation and pay dividends. Placer work requires less preliminary work than does rock work, but it is a poor idea to try to get along without preliminary testing. A few thousand dollars spent testing the ground by drills or otherwise is the best insurance obtainable for the company's capital. This fact is no less true in Cariboo than elsewhere. The glacial debris has so covered the old channels that preliminary prospecting should be done wherever possible.

### Ontario

#### Mining Corporation Resumes—McIntyre To Increase Mill Capacity—Dome Lake and West Dome To Amalgamate

**Cobalt**—The Mining Corporation, which has been closed for the last few months, has resumed operations. The mill capacity has now been brought up to over 300 tons per day, and it is expected that considerable economies in operations can be effected.

The Coniagas mill will soon start handling about 600 tons a day. Of this 300 to 350 tons will be mine rock and 200 to 300 tons old tailings.

The Benson-Gilmour Syndicate has started operations on the old Silver Leaf dump, which the syndicate owns, and will start shipments to the Bailey mill soon.

The Nipissing report for April shows that during the month the company mined ore of an estimated net value of $142,610, and shipped bullion from Nipissing and custom ores of an estimated net value of $177,762. The value of the silver was estimated at 61⅜c. per oz. Underground work was suspended part of the month, on account of the destruction of No. 73 shaft house by fire. The low-grade mill treated 6,633 tons and the refinery shipped 301,075 fine ounces of bullion.

The mill of the Keeley mine in South Lorraine will be operated this summer. A discovery of high-grade was made underground recently.

The Hylands property, which has been closed down for the last twelve years, is to be reopened.

**Porcupine**—It is expected that the McIntyre will soon start to increase the capacity of its mill, and that it will have reached 800 tons a day by next October, and 1,000 tons a day by the end of the year. Orders have already been let for some of the additional machinery, and arrangements are being made to enlarge the mill buildings.

The Dome Lake and West Dome properties, in Porcupine, are to be amalgamated. The main vein on the Dome Lake dips into the West Dome ground at a depth of about 500 ft., and the work done by the Dome Lake showed a considerable improvement in both continuity and values in the vein at this depth. The Dome Lake has a mill of seventy tons' capacity, but a certain amount of both mine and mill equipment has been sold.

The Hollinger has made application for the right to develop 30,000 hp. at Kettle Falls on the Abitibi River. For some time the Hollinger has not been satisfied that the power developed in the Porcupine district would be sufficient to supply the operating mines. The Northern Canada Power Co. develops 15,000 hp. in Porcupine, but it is understood that when the changes contemplated by the Hollinger are completed, that company could use practically the whole of this supply. The Kettle Falls development would require a sixty-mile transmission line to the Hollinger mine. The capacity of the falls, under control, is estimated at 40,000 hp., but the Ontario government would reserve the right to 10,000 hp. for provincial purposes.

The Allied Porcupine is the name of a new company which has taken over the Three Nations and La Palm properties, and arrangements are now being completed for financing mining operations.

**Port Arthur** — The Atikokan blast furnace has been purchased by the Palatine Mining & Development Co., of Chicago, which holds iron ore lands in Cook County, Minn. to reach which it is planned to construct a twenty-one mile connecting link of the Port Arthur, Duluth & Western Ry. to the American boundary. The blast furnace will be rebuilt and its capacity increased from 150 tons of pig iron per day to 225 tons, and ore docks will be constructed at Port Arthur.

## AUSTRALIA

### Queensland

### Mount Morgan Announces Necessity of Cutting Wages or Shutting Down

**Brisbane, April 5**—The manager of Mount Morgan, the only copper-producing mine remaining operative in Queensland and with one exception in Australia, has told the employees that there must either be a reduction in salaries and wages (suggested at 20 per cent) or a closing down. He says that even with that reduction there will be no dividends for the shareholders. The men have decided to leave the matter with the Industrial Arbitration Judge.

## AUSTRIA

### About 132 Mining Enterprises in Country—Lack of Coal Results From Loss of Mines in Czecho-Slovakia

*From Our Berlin Correspondent*

Austria bears a close resemblance to Switzerland in many respects. As to mineral resources, she is even more fortunate than the latter country. She has several gold deposits in the Alps, which have never been properly exploited, on account of their difficult situation. The prospective output did not warrant installation of extensive plant, and the mining of former years was performed in a primitive manner. Under the changed conditions, the gold deposits are now receiving considerable attention. At one of the gold mines in Salzburg, operations were resumed some time ago. An adit is being driven at an altitude of 5,000 ft. and has reached a length of about 600 ft. After the new equipment is installed it is expected that the mine will produce 100 tons of ore per day.

Another gold mine has been in operation since last year in Carinthia. No gold was then produced, but it is believed that a small quantity will be obtained this year.

Other mineral products of the country are graphite and talc in considerable quantities, and some lead, silver, and zinc. Several long-abandoned copper mines in Tyrol have resumed work. The chalcopyrite and pyrite mines of Fragant, in Carinthia, have been taken over by the state and will be enlarged. A new bauxite mine has recently been opened near Salzburg.

The most important of Austria's mineral resources are the iron ore deposits in Styria, which are extensive. The ore is of good quality. They represent a large portion of Austria's national wealth. It is characteristic of the situation into which the country became involved after the war, that in 1919 it suffered the output of this important product to drop to 11 per cent of the full capacity. An increase of 70 per cent took place in 1920, but only 18 per cent of the production of 1916 had thus been reached. The main difficulty is lack of workmen. The old force had dispersed at the end of the war, leaving only a comparatively few native miners. The low purchasing power of the Austrian currency is the main obstacle in the way of filling up the ranks of workmen from outside.

Conveniently near the iron ore there are extensive magnesite deposits. New finds of magnesite of good grade have recently been made, in which great interest is being exhibited by inland and foreign iron works.

The Styrian Alps have also been found to store another wealth of a peculiar quality. Large caves occur which contain thick layers of fossiliferous earth, from which a phosphoric-acid fertilizer can be produced. Operations have been started at several of these caves. Wild rumors of fabulous riches of these deposits are in circulation, but authentic figures are not available. The discovery is, nevertheless, considered of importance, and it helps raise the spirits of the population.

The sorest point of Austria is her lack of coal. The main coal deposits of the former empire are now situated in Czecho-Slovakia. What is left to the country is insufficient for her needs. The total production in 1920 was 134,000 tons of coal and 2,400,000 tons of lignite. A steady increase in production is, however, disclosed by the monthly figures. The coal properties of Austria are in a rather undeveloped state, as they were neglected before the war, owing to the better production of the old empire's northern collieries.

The undeveloped state of the coal-mining industry is characteristic of the whole Austrian mining industry. The equipment of nearly all the mines and the method of mining are antiquated. Not nearly all the resources of the country are being exploited, and in fact it is probable that many valuable deposits have not been discovered yet, as is proved by the recent finds.

The country has now 134 mining enterprises, which may be classified as follows: Graphite and talc, 32; coal and brown coal, 44; lead, silver, and zinc, 14; magnesite, 8; copper, 9; gold, 3; iron, 13, and miscellaneous, 11.

## MEXICO

### Sonora

### Nacozari Consolidated To Resume Development

**Nacozari**—After four months' delay, the Nacozari Consolidated Copper Co. will resume active development work through its main crosscut tunnel, which is being driven northeasterly under the prominent iron-stained capping which extends southeasterly from the Pilares mine of the Moctezuma Copper Co. An extensive development campaign has been planned on the strength of recent results in the tunnel, which have been very encouraging in that the advance has disclosed stringers of copper sulphide ore, increasing in both number and size as the tunnel proceeds. Development is under way on the company's San Pablo property, which continues to disclose high-grade gold-silver-copper-lead ore. A carload of high-grade ore was shipped to the El Paso smelter recently. Both the San Pablo and San Pedro mines are producing milling ore preparatory to resumption of operations at the company's concentrator, which has been remodeled by adding two large oil flotation units. Arrangements are being made for an oil supply for the new power plant which will replace the wood-burning equipment formerly in use. The company has secured a 99-year lease on a tract of 250 acres located less than two miles south of the main workings, which will be developed as a townsite. The main crosscut tunnel has tapped a flow of water ample for milling. Sinking of the San Pablo shaft will continue, and drifts No. 1 and No. 2 will be advanced.

PLANT OF NACOZARI CONSOLIDATED COPPER CO., NACOZARI, SONORA, MEX., IN CENTER. PILARES MINE LOCATION INDICATED IN LEFT BACKGROUND

From the main crosscut, the company plans to advance headings to connect with the Tharsis-York and Copper King shafts, and more extensive prospecting of the large iron-capped formation north of the main workings may be undertaken by means of churn drilling. The officers and directors of the company are: John G. Alexander, president; Thos. D. East, vice-president; B. R. Russell, secretary; Roy Hiatt, treasurer; and R. C. Heath, L. M. Williams, and George Motz. The company's properties are located southeast of Nacozari de Garcia, Sonora, Mexico, and the main office is in Douglas, Ariz.

### Coahuila

**Torreon** — W. H. Williams, manager at Velardeña for the American-Mexico Mining Co., has left for San Antonio, Texas, on account of ill health. Work at Los Libres mines, the principal properties of the company, has been suspended.

**Saltillo**—A group of eleven mining claims has been taken up in the San Marcos mountains district of Monclova by Casmiro Trejo.

The zinc miners of the state of Coahuila are clamoring for a protective tariff on zinc. They claim that the zinc industry is suffering from the lack of interest and assistance by the federal government.

The board of directors of La Perlita Mining Co., with offices in this city and mining properties in different parts of the state, has called for the payment of the third assessment due on the second issue of stock. The amount is one peso per share, payable at the offices of the company in Saltillo. These funds will be employed in general development work and to defray overhead expenses.

### Baja California

Compagnie du Boleo, operating copper mines at Santa Rosalia, Baja California, and purchasing its important supplies and equipment to the extent of approximately $2,000,000 per annum through a purchasing office in San Francisco, is issuing $1,000,000 in 8 per cent serial gold debentures, redeemable at the option of the company in whole or in part at $102 and accrued interest.

## CALIFORNIA

### Wage Scale Reduced at Mother Lode Mines

**San Francisco** — The revised wage scale, representing an average reduction of 50c. per shift, effective May 1, 1921, which, as previously announced, has been generally adopted by mine operators in Amador, Calaveras and Tuolumne counties, California, follows:

| | Per Day |
|---|---|
| Miners | $4.00 |
| Machine men | $4.00 |
| Muckers and trammers | $3.50 |
| Timbermen and pipemen | $4.00 |
| Timbermen helpers | $3.75 |
| Top laborers | $3.25—$3.50 |
| Hoistmen | $4.25—$5.00 |
| Underground hoistmen | $4.00—$4.25 |
| Blacksmith | $4.25—$5.25 |
| Blacksmith helper | $3.50—$3.75 |
| Carpenters | $4.50—$5.25 |
| Timber framers | $3.50—$4.00 |
| Skip tenders and pumpmen | $4.00—$4.50 |
| Tool nippers | $3.50—$4.00 |
| Battery men | $4.00—$4.25 |
| Concentration men | $3.50—$3.75 |

At present approximately 1,500 miners are employed in the mines on the Mother Lode and from 900 to 1,000 in the Grass Valley district. Existing wage agreements in the Grass Valley district are such that no wage changes have been made in this district. Labor is abundant in both districts, and labor efficiency is reported to be steadily increasing.

## NEVADA

### Silverhorn Booming — Amalgamated Pioche To Widen Shaft

**Pioche** — With conditions favoring progress, the big shaft of the Prince Consolidated, now 727 ft. deep, is nearing the bed of silver ore, which lies about 90 ft. below. The data obtained in diamond drilling over a wide area indicates that possibly 200,000 tons of ore, assaying $29.25 in gold and silver, will be available. Favorable smelting rates have been arranged, based on the analysis of drill cores.

A 600-gal. Prescott sinker pump is now lifting the water from the pocket at the 700-level station to the 468 level, eliminating the 593-level pump station.

Arrangements have been completed between the Amalgamated Pioche and the Combined Metals, by which the latter company will start overhauling the power plant at No. 1 shaft. This is preparatory to widening the shaft from the 420 level to the surface. It is planned to put in three boilers, with a capacity of 250 hp., and all the machinery will be overhauled.

Ore shipment from the Pioche district for the two weeks ended May 12 was confined to 408 tons from the property of the Bristol Silver Mines. Other properties are developing or awaiting the expected reduction in freight rates effective May 20 next. A seven-month trial of the increased rates has closed down 75 per cent of the shipping mines at Pioche.

**Silverhorn**—This camp is now a prosperous growing community, and Pioche is benefiting largely through the increased business derived from being the nearest supply point. Only three months old, Silverhorn now has an estimated population of over 200 people, and the surrounding district is being closely searched for profitable ore. It will take many months to prove up the ore reserves on the main properties and determine their true worth, and in the meantime outside properties will be developed that otherwise doubtless would have remained idle.

**Ely**—The Ely district is quiet and daily train service has been reduced to three trains per week. Attention is being given to the outlying portions of the district which in the early days furnished ore discoveries that were responsible for the White Pine boom. Operations are being started on the Hamilton mines, and with an increasing lead price production should be profitable. Gold production in and around Osceola still continues on a small scale. Several big nuggets have been discovered, and in seasons when water is plentiful, sluicing is still carried on in the town gulch. The gold, when it has been found, has been coarse and attractive.

A number of Ely business people have located in the new Silverhorn district.

## UTAH

### Utah Metal & Tunnel Leasing Large Part of Holdings — Utah Con. Installing New Hoist

**Bingham Canyon**—The Utah Metal & Tunnel company is throwing open a considerable portion of its underground holdings to lessees, who will pay royalties of from 25 to 50 per cent, according to the value of the ore developed.

The Utah Consolidated is installing a new 500-hp. Nordberg hoist. No shipments are being made at present, owing to the low price of copper; and no effort will be made to open the new mill until better prices prevail. Seventy men are employed in various ways at the property.

**Eureka** — Shipments for the week ended May 6 amounted to 134 cars, as compared with 126 the week preceding. Tintic Standard shipped 50 cars; Chief Consolidated, 32; Iron King, 16; Iron Blossom, 8; Dragon, 7; Eagle & Blue Bell, 6; Victoria, 4; Gemini, 3; Colorado, 3; Swansea, 2; Eureka Hill, 1; Eureka Mines, 1; Mammoth, 1.

## IDAHO

**Clark's Fork** — On instructions from New York, Compton White, manager of the Clarinda Copper Mining Co., has let a contract to Reed Bros. & Clagg, headed by Joe Reed, a local mining man, for the completion of tunnel No. 5 at the Clarinda property, it is announced by the company. A new drill has been installed and work resumed at the face 930 ft. from the portal. The tunnel will be completed to the Lone-Pine vein a distance of 475 ft.

## MONTANA

### Black Rock Copper Vein 20 Ft. Wide

**Butte**—The vein of copper ore on the 20th level of Butte & Superior's Black Rock (zinc) mine shows a width of 20 ft.

The Anaconda company will continue development work on its phosphate properties.

Crosscutting has been started by the Tuolumne Copper Mining Co. on the 16th level for the Spread Delight vein.

## OREGON

### Rich Gold Discovery at Boswell Mine Attracts Attention

**Grant's Pass**—Much local interest is aroused by the rich gold ore now being mined from the Boswell gold mine near Grant's Pass. This property was recently purchased from R. Boswell by Seattle people, the purchase price being reported at $50,000 cash. Recently the property has been examined by various engineers. It is understood that Mr. Boswell has blocked rich gold ore valued at $50,000, with a few hundred feet of development work. The limits of the pay-shoot are as yet indefinite. Careful sampling has shown that there is a limited tonnage of assured ore, some of which will assay as high as $1,000 in gold per ton. There is a dump of lower-grade ore that has accumulated from previous operations and a small cyanide mill will be built to treat this and the lower-grade mine ore.

## MINNESOTA

### Mesabi Range

### Crosby Mine Closed — Hill - Trumbull Resumes

**Nashwauk**—The Crosby mine has been closed indefinitely. This is the second Cleveland-Cliffs property to close recently. Over 100 men are affected. It is possible that the washing plant will be operated to handle the underground stockpile.

**Marble**—The Hill-Trumbull mine of the Mesaba-Cliffs company has resumed operations at its pit and washing plant. The plant will work to full capacity the whole season and some direct shipping ore will also be forwarded. Work of changing certain portions of the mill is under way.

### Cuyuna Range

### Hillcrest Resumes Open-Pit Mining—Croft Ships 30,000 Tons of Stock Ore and Again Shuts Down

**Ironton**—The Hillcrest mine, Coates & Tweed, operators, resumed open-pit mining on May 16, and will ship at least 100,000 tons this year The normal output at the Hillcrest is 200,000 tons.

The Inland Steel Co. has shipped 40,000 tons of iron ore from its Armour No. 2 stockpile, leaving 50,000 tons in stock which will not be shipped till later in the season. Underground operation is being continued on a one-shift basis with somewhat reduced labor force, maintaining a daily hoist of 300 tons and better.

The Mahnomen mine of the Quinn interests; the Pennington mine, operated by Todd-Stambaugh Co.; and the Feigh mine, M. A. Hanna & Co. (all large shippers in normal years) are still inactive and have no immediate plans for resumption of mining.

Charles W. Potts, of Deerwood, operator of the Northland mine, and the Denison-Schell high-grade manganese mine at Cushman, Ark., called a mass meeting of mine operators and business men recently to urge support of a tariff bill on manganese and manganiferous ores. Mr. Potts has just returned from Washington, where he has devoted several months to backing the fight for a manganese tariff.

**Crosby** — John A. Savage shipped about 30,000 tons of high-grade Bessemer ore from the Croft mine stockpile before May 1, on which date the mine was again closed down and the labor force reduced to a minimum.

**Riverton**—Hydraulic stripping is being continued with marked success at the Sagamore mine, of John A. Savage & Co. Mining has not been resumed but a large amount of construction work is planned. Machinery is being received for a modern screening and drying plant, which will be erected this summer. A concrete and steel machine and carpenter shop will also be completed.

**Trommald**—A steam shovel has been purchased and shipped for open pit operation at the Maroco mine of the Marquette Ore Co., where hydraulic stripping of overburden is nearing completion.

## MICHIGAN

### Gogebic Range

### Despite Apparent Activity, Many Mines Are Down or Running on Reduced Scale

**Ironwood** — The Ashland mine received an order for 10,000 tons of ore for immediate shipment and sent its first ore to the docks on May 2. The several mines of the Oliver Iron Mining Co. started shipping on May 5, and a few days later the steam shovels were started on the stockpiles. Two or three shovels have been kept working every day since, but they may have to be stopped soon, as there is some difficulty on the Lakes about getting boats.

Although there seems to be greater activity on this range than on some of the others, many of the mines are closed down or operating on much reduced scales. The Yale mine of the Charcoal Iron Co. closed down May 3, and only the pumps will be kept working. The Oglebay-Norton Co. has even considered pulling the pumps on some of its properties. The Newport and Anvil-Palms mines, which last year shipped about 2,215,000 tons, will employ only enough men to operate the pumps and do the necessary repairing to keep the shafts and levels from caving in. The old timber-lined portion of "K" shaft may be relined with steel and concrete. The Newport, especially, is troubled with heavy ground, and will probably lose a number of its sub-levels and raises during this forced shut-down. For a number of years it has been the largest underground iron mine in the state.

The Michigan State Tax Commission held a hearing at the Gogebic County Court House on May 12, at which the assessments of the various mining properties in the county were reviewed. Evidence was submitted by some of the mining interests to show that mining properties in the state were assessed at more than their cash value. Michigan mines have fared better than those in Minnesota in the matter of taxes, but still seem to be overvalued.

The valuation of mining property in the city of Ironwood, as established tentatively by the state tax commission, has decreased from $19,878,226 in 1920 to $19,013,677 in 1921, the largest part of this decrease being in the personal property of the Norrie-Aurora-Pabst group of mines, where a cut of $575,135 was made. On account of the showing of ore at the Ashland mine, which a few years ago had worked out all ore in sight, its valuation was raised from $100,000 to $153,036.

### The Copper Country

**Calumet** — The Seneca has acquired the interest in the Lake Milling, Smelting & Refining Co. formerly owned by the Hancock. This gives Seneca company immediate facilities for stamping from 1,000 to 1,200 tons of rock daily and increasing the stamping capacity as desired. This arrangement saves Seneca the time necessary to build a new mill and it also gives it the benefit of the best technical mill talent at the command of the Calumet & Hecla.

# THE MARKET REPORT

## Daily Prices of Metals

| May | Copper, N. Y., net refinery* | Tin | | Lead | | Zinc |
|---|---|---|---|---|---|---|
| | Electrolytic | 99 Per Cent | Straits | N. Y. | St. L. | St. L. |
| 12 | 12.50@12.75 | 31.75 | 32.75 | 5.00@5.15 | 4.95 | 4.90 |
| 13 | 12.50@12.75 | 31.675 | 32.75 | 5.00@5.10 | 4.90@4.95 | 4.90 |
| 14 | 12.75 | 31.50 | 32.50 | 5.00 | 4.85@4.90 | 4.85 |
| 16 | 12.75 | 31.25 | 32.375 | 5.00 | 4.85 | 4.85 |
| 17 | 12.75 | 32.00 | 33.00 | 5.00 | 4.85 | 4.85 |
| 18 | 12.75 | 32.00 | 33.00 | 5.00 | 4.85 | 4.85 |

*These prices correspond to the following quotations for copper, "delivered": 12.75@13c. for May 12 and 13; 13c. for May 14, 16, 17 and 18.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York, cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin.

## London

| May | Copper | | | Tin | | Lead | | Zinc | |
|---|---|---|---|---|---|---|---|---|---|
| | Standard | | Electrolytic | | | | | | |
| | Spot | 3 M | | Spot | 3 M | Spot | 3 M | Spot | 3 M |
| 12 | 72⅜ | 71¾ | 73½ | 179 | 181 | 24⅛ | 23⅞ | 26¾ | 27⅜ |
| 13 | 73⅛ | 72⅛ | 74 | 178¾ | 180 | 23¼ | 23¼ | 26½ | 27½ |
| 14 | ... | ... | ... | .... | .... | ... | ... | ... | ... |
| 16 | ... | ... | ... | .... | .... | ... | ... | ... | ... |
| 17 | 74⅛ | 73⅜ | 74½ | 181 | 182¾ | 23⅝ | 23½ | 27 | 27⅞ |
| 18 | 74½ | 73¾ | 75 | 180⅞ | 182 | 23⅜ | 23⅞ | 27⅛ | 28⅜ |

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

## Silver and Sterling Exchange

| May | Sterling Exchange | Silver | | | May | Sterling Exchange | Silver | | |
|---|---|---|---|---|---|---|---|---|---|
| | | New York, Domestic Origin | New York, Foreign Origin | London | | | New York, Domestic Origin | New York, Foreign Origin | London |
| 12 | 398½ | 99¼ | 60⅞ | 34½ | 16 | 399½ | 99¼ | 59¾ | ... |
| 13 | 399½ | 99¼ | 60¼ | 34¼ | 17 | 399 | 99¼ | 59⅝ | 33¾ |
| 14 | 399¾ | 99¼ | 59¾ | 33⅞ | 18 | 399⅜ | 99¼ | 59⅛ | 33½ |

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine.

## Metal Markets

**New York, May 18, 1921**

The week has been a quiet one, with little demand for any of the metals, especially from domestic consumers, who have yet to feel any increased general business activity.

### Copper

As a result of curtailed production and a satisfactory export demand, the copper market has maintained the stronger tendency of recent weeks, and the price has gradually crept upward. Today we know of no one willing to sell even prompt copper for less than 13c., delivered, and producers are in some cases quoting as high as 13.25c. for May shipments, and are not anxious to sell at that price. The feeling is general among producers that conditions will slowly improve and that they will lose more by selling at present prices than the loss of interest by holding the metal. The export demand is generally sufficient to take care of current output, so that domestic demand must be supplied from higher-cost stocks. However, practically no copper is being sold to domestic consumers. A large cable company was inquiring for prices on six or seven hundred tons yesterday, but orders for lots of this size are infrequent. Conditions are reported particularly unsatisfactory just now among copper consumers in the Middle West. Copper for shipment later than May is obtainable at a premium of about ¼c. per month. Copper for export sold at 13c., c.i.f. European ports until Friday, when the Export Association raised the price to 13.25c.

### Lead

The official price of the A. S. & R. Co. remained all week at 5c., New York and St. Louis.

The demand for lead was fair on Thursday, but since then practically all producers report no sales and few inquiries. This let-up in demand has had the effect of putting a brake on the constantly increasing price of recent weeks, in fact, as soon as it was seen that consumers' interest was failing producers were disposed to do business at somewhat lower levels. Today it is possible that a preferred consumer could buy lead in St. Louis at 4.75c., although we have heard of no sales being made at that figure. These conditions have brought some speculative holdings into the market which were offered somewhat above the figures which we quote but which generally went unsold. It is considered that present consumption is greater than production, and as the stocks are not so large as to be a menace, the present setback is likely to be only temporary.

### Zinc

Practically all of the zinc sold during the week was marketed at a concession of 5 points from last week's closing quotation of 4.90c., St. Louis. The market is dull, and inquiries are light, the demand that helped to improve prices a short time ago having disappeared almost entirely. Producers in general are not pressing sales, and are making but few offerings. The London market has improved £1 12½s. over the last seven days and is now £27 17½s. A further rise of approximately £1 10s. would put the American zinc industry on an export basis, a result that should have highly beneficial consequences. Although little interest is shown in futures, quotations of 4.90c. for June and 4.95c. for July are being made. High-grade zinc is selling for 6.75c., with customary freight allowance of not more than 30 points.

### Tin

The tin market is almost entirely in the hands of speculators, who are making a little money dabbling in small lots and taking advantage of London fluctuations. The market was strong on Thursday but very easy over the week-end in the absence of London buying orders. Local dealers expected a depressed London tin market on Tuesday in view of the Silesian difficulties, but were mistaken. A small tonnage of electrolytic tin was sold to consumers

at prices which averaged about ⅛c. under those of Straits. Tin for forward delivery was quiet at the same prices as for spot Straits to ⅛c. higher.

Arrivals of tin, in long tons: May 12, London, 75; May 16, London, 20; May 17, London, 50.

## Gold

Gold in London: May 12, 103s.; May 13, 102s. 11d.; May 17, 102s. 11d.; May 18, 102s. 9d.

General stock of money in the United States, May 1: Gold coin (including bullion in Treasury), $3,089,679,782; standard silver dollars, $276,482,326; subsidiary silver, $271,058,297; United States notes, $346,681,016; Federal Reserve notes, $3,059,943,360; Federal Reserve Bank notes, $175,014,400; National Bank notes, $723,816,352; total, $7,942,675,533. The outstanding notes decreased about $232,000,000 during April, and the gold and silver increased about $92,000,000.

## Foreign Exchange

Practically all European exchanges exhibited stronger tendencies during the week and trading was in many instances of larger volume than usual. On Tuesday, May 17, francs were 8.48c.; lire, 5.525c.; and marks, 1.735c. New York funds in Montreal, 11 7/8 per cent premium.

## Silver

The silver market has been dull and narrow the last week, with weaker tendency due to selling by the Indian bazaars, the only support to the market being bear covering by China buyers. The London price has fallen from 34½ to 33¾d. and closes dull. Domestic demand continues light and on a small scale. The future tendency for silver seems uncertain, with no important rise probable until there is a revival in trade in the Far East.

**Mexican Dollars**—May 12, 46⅝c.; 13th, 46c.; 14th, 45⅝c.; 16th, 45⅝c.; 17th, 45⅝c.; 18th, 45¼c.

## Other Metals

Quotations cover large wholesale lots unless otherwise specified

**Aluminum**—List prices of 28@28.5c. are nominal. Outside market, 22@23c. per lb.; 22½c. for imports, duty paid.

**Antimony** — Chinese and Japanese brands, 5¼c.; market dull. W.C.C. brand, 5¾@6¼c. per lb. Cookson's "C" grade, spot, 9⅜c. Chinese needle antimony, lump, nominal at 4½c. per lb. Standard powdered needle antimony (200 mesh), nominal at 6@6½c. per lb.

**White antimony oxide, Chinese, guaranteed 99 per cent $Sb_2O_3$, wholesale lots, 6½@7c.**

**Bismuth**—$1.50@$1.55 per lb., 500-lb. lots.

**Cadmium**—Range $1@$1.10 per lb., in 1,000-lb. lots. Smaller quantities, $1.10@$1.25 per lb.

**Cobalt**—Metal, $4 per lb.; black oxide, $3@$3.10 per lb. in bbls.; sulphate, $1.35 per lb. in bbls.

**Iridium**—Nominal, $250@$300 per oz.

**[1]Molybdenum Metal in rod or wire form, 99.9 per cent pure, $32@$40 per lb., according to gage.**

**Nickel**—Standard market, ingot, 41c.; shot, 41c.; electrolytic, 44c. Small tonnages, spot, 38@40c.

**Monel Metal**—Shot, 35c.; blocks, 35c., and ingots, 38c. per lb., f.o.b. Bayonne.

**Osmium**—$70@$80 per troy oz.

**Palladium**—$65@$70 per oz.

**Platinum**—$72@$75 per oz.

**Quicksilver**—Nominally, $46@$48 per 75-lb. flask. San Francisco wires $47. Steady.

**[1]Rhodium**—$200@$225 per troy oz.

**Ruthenium**—$175@$200 per troy oz.

**[1]Selenium**—Black powdered, amorphous, 99.5 per cent pure, $2@$2.25 per lb.

**[1]Thallium Metal**—Ingot, 99 per cent pure, $20 per lb.

**[1]Tungsten Metal—Wire, $35@$60 per kilogram, according to purity and gage.**

## Metallic Ores

**Chrome Ore—Guaranteed 50 per cent $Cr_2O_3$ foreign ore with a maximum of 6 per cent silica, 45@55c. per long ton unit, f.o.b. Atlantic ports.**

**Iron Ore**—Lake Superior ores, per ton, Lower Lake ports: Old Range bessemer, 55 per cent iron, $7.45; Mesabi bessemer, 55 per cent iron, $7.20; Old Range non-bessemer, 51½ per cent iron, $6.70; Mesabi non-bessemer, 51½ per cent iron, $6.55.

**Magnetite Ore**—F.o.b. Port Henry, N. Y.: Old bed 21 furnace, $5.80; old bed concentrates, 63 per cent, $6.70; Harmony, cobbed, 63 per cent, $6.70; new bed low phosphorus, 65 per cent, $9.50.

**Manganese Ore**—25@30c. per unit, seaport; chemical ore ($MnO_2$) $55@$60 per gross ton, lump; $70@$75 per net ton, powdered.

**Molybdenum Ore**—85 per cent $MoS_2$, 55@60c. per lb. of contained sulphide, New York.

**Tantalum Ore**—Guaranteed minimum 60 per cent tantalic acid, 50c. per lb. in ton lots.

**[1]Titanium Ores**—Ilmenite, 52 per cent $TiO_2$, 1¼@2c. per lb. for ore. Rutile, 95 per cent $TiO_2$, 12c. per lb. for ore, with concessions on large lots or contracts.

**Tungsten Ore**—Scheelite or wolframite, 60 per cent $WO_3$ and over, per unit of $WO_3$ $3@$3.75, f.o.b. Atlantic ports.

**Uranium Ore (Carnotite)—Ore containing 1½ per cent $U_3O_8$ and 5 per cent $V_2O_5$ sells for $1.50 per lb. of $U_3O_8$ and 75c. per lb. of $V_2O_5$; ore containing 2 per cent $U_3O_8$ and 5 per cent $V_2O_5$ sells for $2.25 and 75c. per lb., respectively; higher $U_3O_8$ and $V_2O_5$ content commands proportionately higher prices.**

**Vanadium Ore—$1.50 per lb. of $V_2O_5$ (guaranteed minimum of 18 per cent $V_2O_5$), New York.**

**[1]Zircon—Washed, iron free, 3c. per lb.**

**[1]Zirkite—According to conditions, $70 @$90 per ton, carload lots. Pure white oxide, 99 per cent, is quoted at $1.15 per lb. in ton lots.**

[1]Furnished by Foote Mineral Co., Philadelphia, Pa.

## Zinc and Lead Ore Markets

**Joplin, Mo., May 14**—Zinc blende, per ton, high, $28.35; basis 60 per cent zinc, premium and Prime Western, $25; fines and slimes, $22.50@$20; calamine, basis 40 per cent zinc, $12. Average settling prices: Blende, $24.35; calamine, $15; all zinc ores, $24.29.

Lead, high, $58.90; basis 80 per cent lead, $60; average settling price, all grades of lead, $56 per ton.

Shipments for the week: Blende, 4,627; calamine, 30; lead, 1,439 tons. Value, all ores the week, $193,740.

No buyer offered over $25 basis this week, sellers holding back. Lead ore demand sent the basis up $2.50 per ton again, advancing the price to $60 basis, a steady increase from $35 the end of February. Low production is responsible for an unwarranted price basis.

**Platteville, Wis., May 16**—Blende, basis 60 per cent zinc, $28 per ton base offered, but operators carrying stocks are holding for advance. Lead ore, basis 80 per cent lead, $55 per ton. For the first time in two decades no finished blende was shipped out of the Wisconsin district. Shipments for the week: Lead ore, 91 tons. Shipments for the year: Blende, 11,461; lead ore, 659 tons. Shipped during the week to separating plants, 818 tons blende.

## Non-Metallic Minerals

**Asbestos — Crude, No. 1, $2,000@ $3,000; No. 2, $1,400@$2,000; spinning fibres, $400@$1,000; magnesia and compressed sheet fibres, $325@$500; shingle stock, $110@$150; paper stock, $60@ $75; cement stock, $17.50@$30; floats, $8.50@$15, all per short ton, f.o.b. Thetford, Broughton, and Black Lake mines, Quebec, Canada; 5 per cent to be added as export sales tax.**

**Barytes**—Crude, 88 to 94 per cent barium content, $10@$12 per net ton; ground (white) $24@$30 in bags, carload lots; (off-color) $22@$26 in bags, carload lots; all f.o.b. South Carolina points. Foreign barytes, prime white material, $25 per net ton f.o.b. Atlantic seaports. Western grades are $24.50. Crude quoted $7 per long ton, f.o.b. Cartersville, Ga. Small lots as low as $5.

**Bauxite**—High-grade French bauxite, $8@$10 per ton, Atlantic ports. American quotations the same. Consumers generally well supplied. Prices vary according to grade. Crude, unground, $16.50 per ton; ground, $22; calcined, ground $35; unground, $45, f.o.b. plant.

**Chalk**—English, extra light, 5@5½c. Domestic light, 4½@5c.; heavy, 4@4½c. per lb., all f.o.b. New York.

**China Clay (Kaolin)**—Crude, $8@ $10; washed, $10@$12; powdered, $15@ $20; bags extra, per net ton, f.o.b. mines, Georgia; powdered clay, $15@ $20, f.o.b. Virginia points. Domestic lump, $10@$20; powdered, $25@$30; imported lump, $15@$25, f.o.b. American ports; powdered, $35@$45, f.o.b. New York.

**Emery**—Turkish emery, 6@6½c. per lb., depending upon fineness. Inferior grades, 3½c. f.o.b. New England points.

**Feldspar**—Crude, $8@$14 per gross ton, f.o.b. Maryland and North Carolina points; $7.50@$10, f.o.b. Maine; ground, $27@$30, car lots, f.o.b. Baltimore; ground, $17@$21, f.o.b. North Carolina points; $17@$21 per ton, No. 1 ground, f.o.b. New York State; $21@$23 per ton, ground, f.o.b. Maine.

**Fluorspar** — Gravel, guaranteed 85 per cent calcium fluoride and not over 6 per cent silica, $20@$25 per ton, f.o.b. Illinois and Kentucky mines; acid, glass, and enamel grades, $40@$55; ground, suitable for acid, chemical or enameling purposes, $32@$35; lump, $15, f.o.b. Lordsburg, N. M. Ground acid grade, 97 per cent $CaF_2$, $32, New Mexico, Canadian price generally $18 (Canadian currency) per ton, f.o.b. mines. Market is improving in western ground acid grades for glass and enamel manufacture.

**Fuller's Earth**—16 to 30 mesh, $21; 30 to 60 mesh, $23; 60 to 100 mesh, $19; 100 plus mesh, $15, f.o.b. plants, Pennsylvania. California grades, $15@$25, f.o.b. mines. Imported, English, $24@$27, f.o.b. Atlantic ports.

**Graphite**—Ceylon lump, first quality, 7½@8c. per lb.; chip, 6@6½c.; dust, 4@4½c. No. 1 flake, 7c.; amorphous crude, ¾c.@2¼c.

**Gypsum**—Plaster of paris in carload lots sells for $4.25 per 250-lb. bbl., alongside dock, New York. Raw crushed rock, $3.50@$4.50; calcined stucco, $9; f.o.b. works, Illinois.

**Kaolin**—See China Clay.

**Limestone**—Crushed, New York State shipping points, ¾ in. size, $1.40@$2 per net ton; 1½ in., $1.50@$2. Prices for other sizes practically the same. Agricultural limestone, $2.50@$4.50 per net ton, f.o.b. eastern shipping points, depending upon analysis.

**Magnesite**, Calcined — Crude, $12@$15 per ton. High-grade caustic calcined, lump form, $30@$40 per ton. Plastic calcined, $56 in barrels, carload lots, f.o.b. California points. Atlantic seaboard, $60.

**Dead-Burned** — $38 per net ton, Chewelah, Wash.; $58@$64, Chester, Pa. Austrian grade, $55@$60 per ton, f.o.b. Baltimore. (Magnesite brick—See Refractories.)

**Mica**—India block mica, slightly stained, per lb.: No. 6, 35c.; No. 5, $1.20; No. 4, $2.50@$3; No. 3, $3.50@$4; No. 2, $4.50@$6; No. 1, $5.50@$6.50. Clear block: No. 6, 50c.; No. 5, $1.75; No. 4, $3.25; No. 3, $5; No. 2, $6.50; No. 1, $8; A1, $6.50@$8.50; extra large, $25; ground, wallpaper grade, $90@$160 per ton (depending upon quantity); ground roofing mica, $25@$70, all f.o.b. New York.

[1]**Monazite** — Minimum of 6 per cent thorium oxide, quoted $30 per unit, duty paid.

**Phosphate Rock**—Per long ton, Florida ports: 77 per cent tricalcium phosphate, $12.50; 75 per cent, $11.50; 75@74 per cent, $11; 70 per cent, $6.75; 68 per cent, $6.25; 68@66 per cent, $6.

[1]Foote Mineral Co., Philadelphia, Pa.

**Pumice Stone**—Imported, lump, 4@50c. per lb.; domestic lump, 6c.; ground, 4@7c., all f.o.b. New York.

**Pyrites**—Spanish fines, per unit, 14c., c.i.f. Atlantic seaport; furnace size, 14c.; Spanish lump, 12@14c.; domestic fines, f.o.b. mines, Georgia, 12 @ 14c.

**Silica** — Glass sand, $2.25 per ton; sand-blast material, $2.25, both f.o.b. Indiana points. Amorphous or decomposed variety, soft silica, 250 to 500 mesh, $16@$30 per ton. Ganister, crude, $2.50 per ton, f.o.b. Illinois points. Molding sand, building sand, glass sand, $2.25@$3, f.o.b. Pennsylvania points. Market reported dull.

**Sulphur**—$18 per ton for domestic; $18@$20 for export, f.o.b. Texas and Louisiana mines. Market quiet.

**Talc**—Paper making, $11@$20 per ton; roofing grades, $8.50@$13; rubber grades, $11@$13; all f.o.b. Vermont. California talc, $18@$40, talcum powder grade. Southern talc, powdered, carload lots, $10@$14 per ton; less than carload, $25, f.o.b. cars. Imported, $35@$40; Canadian, $20@$40 per ton.

## Mineral Products

**Arsenic**—White arsenic, 7¾@8c. per lb. in carload lots.

**Sodium Nitrate**—$2.75@$3 per cwt. ex vessel, Atlantic ports.

**Sodium Sulphate**—For 95 per cent material, $20 per ton, f.o.b. mines, Idaho and Arizona, spot and six months' contract; $33@$35 per ton, New York.

**Potassium Sulphate**—Powder, domestic, $1.75@$1.80 per unit, basis 90 per cent, f.o.b. New York.

## Ferro Alloys

**Ferrotitanium**—For 15 to 18 per cent material, $200@$225 per ton, f.o.b. Niagara Falls, N. Y.

**Ferrocerium**—Per lb., $12@$15.

**Ferrochrome**—Carload lots, spot and contract, 60 to 70 per cent chromium, 6 to 8 per cent carbon, 15c. per lb. of chromium contained; 4 to 6 per cent carbon, 16@17c., f.o.b. works.

**Ferromanganese**—Domestic 76 to 80 per cent, $80@$85, f.o.b. furnace; resale, $90, delivered; English, $80@$85, c.i.f. Atlantic seaports. Spiegeleisen, 18@20 per cent, $32, f.o.b. furnace.

**Ferromolybdenum**—Standard grades, carrying from 50 to 60 per cent molybdenum metal, with low sulphur, phosphorus, and arsenic, $2.50 per lb. of contained metal, f.o.b. works.

**Ferrosilicon**—For 10 to 15 per cent, per gross ton, f.o.b. works, $50@$55; 50 per cent, $80@$85; 75 per cent, $145@$150.

**Ferrotungsten**—Domestic, 70 to 80 per cent W, 50@55c. per lb. of contained tungsten, f.o.b. works. Foreign, 50c., duty paid, f.o.b. Atlantic ports.

**Ferro-uranium**—35 to 50 per cent U, $6 per lb. of U contained, f.o.b. works.

**Ferrovanadium**—$5@$6 per lb. of V contained, according to analyses and quantity.

## Metal Products

**Copper Sheets**—Current New York list price, 20½@20¾c. per lb.; wire, 15c.

**Lead Sheets**—Full lead sheets, 7¾c.; cut lead sheets, 8c. in quantity, mill lots.

**Nickel Silver** — 33½c. per lb. for 18 per cent nickel.

**Yellow Metal** — Dimension sheets 18¼c.; sheathing, 17¼c.; rods, ⅝ to 3 in., 15¼c.

**Zinc Sheets**—$11 per 100 lb., less 8 per cent on carload lots, f.o.b. smelter; zinc plates, 10c. per lb.

## Refractories

**Bauxite Brick**—56 per cent alumina, $35@$50 per ton, f.o.b. works.

**Chrome Cement**—40@45 per cent $Cr_2O_3$, $45@$50 per net ton, and $55 in sacks, carload lots, f.o.b. eastern shipping points.

**Chrome Brick**—Straights, $75 per net ton, shipping point; arches, keys, wedges, $80; splits, soaps, $90.

**Fire Brick**—First quality, 9-in. shapes, $40@$50 per 1,000, Pennsylvania, Ohio and Kentucky. Second quality, $30@$35.

**Magnesite Brick**—9-in. straights, $90@$95 per net ton; 9-in. arches, wedges and keys, $100; soaps and splits, $110.

**Silica Brick**—9-in., per 1,000: $45@$55 in carload lots, f.o.b. shipping points.

## The Iron Trade

**Pittsburgh, May 17, 1921**

It is now the common view that the demand for steel during the next three months will be less than the rate of production has been in the last few weeks. Buying is particularly light.

Production of steel ingots is running a shade lighter than the average of April, being about 15,000,000 tons a year, or a trifle under a 30 per cent rate. The Steel Corporation is operating at between 35 and 40 per cent and the independents at between 20 and 25 per cent.

The steel prices that became the general market a month ago are being well maintained, but the real test is regarded as to come in the next few weeks.

**Pig Iron**—A merchant furnace interest has sold a steel works 2,000 tons of basic iron, both buyer and seller being in the Shenango Valley. The price was $22, furnace, or 50c. under the price at which a steel works had been selling surplus iron, and which merchant furnaces for a time refused to meet. Bessemer is quoted at $24, Valley, against the former nominal quotation of $25. Foundry is offered at $23.50, Valley, against $24 formerly quoted. Demand is light for all grades.

**Steel**—Prices remain at $37 for billets, $38 for slabs, $39 for sheet bars and small billets, and $48 for rods.

## Coke

**Connellsville**—Furnace, $3.25@$3.75; foundry, $4.50@$5.

# The Recovery in Lead

## The Market Has Risen Steadily Since February, and Large Transactions Have Been Recorded—The Penarroya Co., With Spanish Lead, Actively Competing in American Markets—Continued Rise May Hinder Attempt To Obtain a High Tariff

EDITORIAL MARKET STUDY

THE LEAD MARKET has lately shown a surprising amount of strength, and the New York price is now around 5c. On Feb. 26 last, New York lead was sold for 3.75c., but since that date the market has steadily improved, and at present shows a stronger undertone than for months. Curtailment of production has had something to do with the improvement, but this influence is probably exaggerated, because of the pardonable reluctance of certain Western lead producers to decrease lead production, the "dollar silver" recovered being the chief stimulus to present day non-ferrous metal mining.

The principal contributory cause to the betterment in lead has been the regular and insistent demand for the metal, a demand that is fortunately confined to no one source, but is well distributed among the many classes of lead consumers. All the leading lead-producing companies have booked heavy orders for their product and have recorded a heavier amount of business than for many months. They have been able not only to improve their financial position, but, by making an inroad on surplus stocks, which had threatened to increase, have improved their statistical position. Another lull in buying will find the lead producer in a good position to weather the readjustment period.

### Effect of Foreign Lead on Domestic Price Is Negligible

At the same time that lead buying has increased, the usual irritating damper, in the form of a steady or declining London market, coupled with imports into the United States, was not a strong element. It is true, as current reports indicated, that negotiations looking to the shipment of more than 5,000 tons of Spanish lead were concluded by the agents of the Penarroya Co. in this country and that about 2,000 tons additional Spanish lead will be available in the domestic market, but, nevertheless, there has been little disposition to sell the uncontracted metal at prices lower than the American product.

London quotations have risen contemporaneously with those of New York and St. Louis, despite the reports of large stocks in London (24,000 tons) and quiet trading. It may well be that these stocks are in strong hands, and hence are not likely to disturb the rise, and that speculation in the metal is a prominent trade factor. Real support to the London market is reported to come from German purchases of Spanish lead, and to absence of new supplies from Australia and other countries. At £24, and current rates of exchange, lead cannot be profitably exported and laid down in Atlantic ports under 5c. per lb., so that the American market is not on a parity with London.

### Activities of the Penarroya Company

Spain has important lead resources and produces from one-third to one-half as much lead as the United States. Prior to the war, production ranged from 175,000 to 203,000 metric tons. In 1919, the last year for which statistics are available, production was 125,722 metric tons. The following table from the *Metallgesellschaft's* compilations furnishes details of individual years:

SPANISH LEAD PRODUCTION IN METRIC TONS

| | | | |
|---|---|---|---|
| 1909 | 184,000 | 1915 | 161,500 |
| 1910 | 191,900 | 1916 | 175,000 |
| 1911 | 175,000 | 1917 | 155,400 |
| 1912 | 186,700 | 1918 | 146,300 |
| 1913 | 203,000 | 1919 | *(a)*125,720 |
| 1914 | 153,100 | | |

*(a)* From a consular report published in *Commerce Reports*, March 31, 1921.

The Société Minière et Metallurgique de Penarroya, which has frequently figured in market reports, is a Franch organization, of $14,625,000 capitalization (the U. S. currency equivalent of 292,500 shares of 250 fr. par value), and operates lead-silver mines at Penarroya, Province of Teruel, Spain, coal mines in the same vicinity, lead mines in the Pyrenees, and also mines in Algiers and Tunis, northern Africa. The company owns or controls every lead smelter in Spain, and, besides its private smelter at Penarroya, operates another at Marseilles, France. A new reduction plant, roasting and smelting equipment (American built), insures modern and efficient operation. The Penarroya company is a member of a French trade association or "consortium," the Société Minerais et Metaux, a highly centralized organization formed for mutual protection and organization in trade competition with other nationals, and occupies a strong position in the French and Spanish lead industries.

The lead from Spain can be readily shipped directly to London, Germany, or the United States and does not have to be handled through London, enabling it actively to compete in the three markets mentioned. Usually the direct calculation based upon the London quotation, and upon shipment of lead from English ports, furnishes a higher estimate of the cost of selling Spanish lead in American markets, because the metal can be shipped directly from Spain at a saving in freight rates.

### Demand for Lead From All Classes of Consumers

The consumption of new lead in American industries has been exceptionally well diversified and bespeaks a recovery in many manufacturing enterprises. Although it may be stretching the point too far, the omen may be one of the indications that conditions are improving and that the country is slowly but gradually emerging from the present period of depression.

Lead has a wide variety of uses and enters into the manufacture of cables, pipe, sheets, foil, batteries, babbitts, solder, bearing metals, ammunition, type metals, brasses, white lead, battery oxides and red lead and other pigments. This wide diversity of application emphasizes the inference that a demand for lead is an excellent trade barometer for general business conditions, were it not for the fact that lead has during the last year or more behaved differently from other metals and only recently touched relatively low points. Although no detailed figures are available covering the normal percentages of lead consumed by the various industries, the following order of importance is a deduction made from a table prepared by the War Industries Board during war time: Lead cable, white lead, ammunition, lead pipe, sheet lead, batteries, babbitts and solders.

It is, of course, idle to predict whether the advance in lead will grow or wither. For every reason to forecast a further rise in price, another reason can be advanced pointing to a decline. Lead producers were more fortunate than other metal producers in 1920, and the record made so far this year would appear to presage a duplication of this record. If the market should continue to strengthen, the lead producers' cry for a higher protective tariff would no doubt be inconsistent with conditions. However, they would be quick to argue that the present rise in price is merely temporary and that the danger of heavy importations is still formidable—to which the best answer will be the price of lead during the next few months, and a clarification of the still troublesome European situation or a return to actual peaceful conditions.

# COMPANY REPORTS

## Kennecott 1920 Surplus More Than Double

A report of operations of Kennecott Copper Corporation for 1920 states that 51,365,261 lb. of copper and 507,727 oz. of silver were received at the smelter. Cost of production, including all credits and charges except depletion, was 10.84c. per lb. Income account follows:

| | | |
|---|---|---|
| Operating revenue | | |
| Copper sold | 45,487,855 lb. @ 17.415c. | $7,921,928.55 |
| Silver sold | 507,726.88 oz. @ $1.0148 | 515,262.07 |
| | | $8,437,190.62 |
| Operating cost | | |
| Mining and milling | $2,373,424.71 | |
| Treatment, refining, and freight | 2,320,535.39 | |
| Selling and delivery charges | 320,163.04 | |
| General expense | 171,576.87 | 5,185,700.01 |
| | | $3,251,490.61 |
| Miscellaneous income at mines | | 7,897.61 |
| Profit on metals sold | | $3,259,388.22 |
| Other income | | |
| Dividends and interest | | 3,217,632.60 |
| Total income for year | | $6,477,020.82 |
| Deduct interest and taxes | | 1,279,686.38 |
| Balance to undivided profits | | $5,197,334.44 |
| Undivided profits | | |
| Balance as stated, Dec. 31, 1919 | | 7,511,404.59 |
| Add—sundry adjustments in compliance with U. S Treasury Department tax rulings | | 9,900,971.65 |
| Balance as adjusted Dec. 31, 1919 | | $17,412,376.24 |
| Income for year, as above | | 5,197,334.44 |
| | | $22,609,710.68 |
| Depreciation of construction and equipment | $222,104.06 | |
| Depletion for year | 3,505,832.67 | |
| Dividends Nos. 17, 18, 19 and 20 (but not including capital distributions amounting to $2,787,081) | 2,787,081.00 | 6,515,017.73 |
| Balance of undivided profits Dec. 31, 1920 | | $16,094,692.95 |

Capitalization 2,787,081 $\frac{2}{13}$ shares of no par value.

## Copper Range Paid Smallest Dividends In 1920

A report of operations of the Copper Range Co. for 1920 states that $591,625.50 was paid in dividends on the 394,309 shares outstanding of $25 par, the smallest dividends ever paid by this company. Consolidated operating statement follows:

| | | |
|---|---|---|
| 23,756,267 lb. of copper produced and sold at average of 17.148c. per lb | | $4,073,883.82 |
| Interest | | 150,521.74 |
| Atlantic Mining Co. income from rents, interest, etc | | 8,358.45 |
| | | $4,232,764.01 |
| Mining expense, exploration, smelting, freight, sales department and all other expenses | | 3,692,779.01 |
| | | $539,985.00 |
| Taxes paid by mining companies | | 436,477.67 |
| | | $103,507.33 |
| Operating income of Copper Range R.R. Co. (which includes Government compensation and guaranty) | $205,540.31 | |
| Less interest on bonds | 114,000.00 | 91,540.31 |
| | | $195,047.64 |
| Deduct one-half of net mining profit of Champion Copper Co., which belongs to the St. Mary's Mineral Land Co | | 199,886.32 |
| Operating deficit | | $4,838.68 |

Cost of production was 17.77c. per lb.

## Arizona Commercial Mining Co.

A report of operations of the Arizona Commercial Mining Co. for 1920 states that 7,913,836 lb. of refined copper, 31,028 oz. of silver, and 1,722 oz. of gold was produced. Income account showed $1,020,223.47 received for copper, silver, and gold. Mining, treatment, and refining plus inventory losses amounted to $717,615.14; general expenses, $93,922.47; depreciation, $46,891.10; depletion, $194,930; loss for the year, $33,135.24. Surplus balance on Dec. 31, 1919, was $2,372,978.96; on Dec. 31, 1920, $2,339,843.72.

## Alaska Juneau Deficit Decreases

A report of operations of the Alaska Juneau Gold Mining Co. for 1920 says that $732,870 of gold, 23,348 oz. of silver, and 487,574 lb. of lead were produced, compared with $499,002 of gold, 16,431 oz. of silver and 19,367 lb. of lead in 1919. Operating statement follows:

| | 1920 | 1919 | Total to Date |
|---|---|---|---|
| Production—(Gross recovered gold, silver, and lead values) | 942,870 Tons | 692,895 Tons | 3,327,834 Tons |
| Bullion | $583,134.82 | $400,644.29 | $1,820,242.54 |
| Concentrates | 208,255.17 | 142,069.70 | 816,677.18 |
| Expenditures | $791,389.99 | $542,713.99 | $2,639,919.72 |
| Mining: | | | |
| Prepaid mining | 9,428.70 | 43,693.95 | 131,131.98 |
| Stoping | 22,701.81 | 13,947.12 | 424,738.75 |
| Bulldozing | 88,444.67 | 74,175.56 | 298,400.62 |
| Tramming | 75,142.20 | 74,309.89 | 312,922.03 |
| Total | $195,717.38 | $206,126.52 | $1,167,193.38 |
| Milling: | | | |
| Coarse crushing | $53,767.86 | $50,843.58 | $221,897.19 |
| Intermediate crushing | 228,092.35 | 192,667.65 | 619,818.87 |
| Fine crushing | 17,594.41 | 86,671.07 | 566,670.46 |
| Concentration | 23,165.19 | 18,904.35 | 145,471.68 |
| Re-treatment | 22,940.27 | 22,113.21 | 97,309.01 |
| Sorting | 75,270.87 | 17,379.44 | 98,937.33 |
| Total | $420,830.95 | $388,579.30 | $1,750,104.54 |
| Other Juneau operating and marketing costs | 84,320.10 | 63,382.88 | 404,643.45 |
| Total Juneau operating and marketing costs | $700,868.43 | $658,088.70 | $3,321,941.37 |
| All other costs and interest | 157,972.63 | 138,606.03 | 492,007.01 |
| Total operating costs | $858,841.06 | $796,694.73 | $3,813,948.38 |
| Juneau operating profit-deficit | $90,521.56 | $115,374.71 | $685,021.65 |
| Net profit-deficit — (1914-1920 inclusive) | $67,451.07 | $253,980.74 | $1,177,028.66 |
| Capital and other assets: (August, 1911, to December, 1920, inclusive.) | | | |
| Property and plant | $203,415.14 | $142,375.61 | $3,449,227.78 |
| Deferred charges: | | | |
| Preparatory mining | 69,336.17 | 41,288.53 | 486,236.20 |
| Mine development | 21,384.47 | 66,308.66 | 786,818.97 |
| Total | $294,135.78 | $249,972.80 | $4,722,282.95 |
| Total of all expenditures | $1,152,976.84 | $1,046,667.53 | $8,536,231.33 |
| Surplus-deficit | $361,586.85- | $503,953.54 | $5,899,311.61 |

## Nipissing Mines Co. Net Profit $1,279,091

A report of operations of the Nipissing Mining Co. for 1920 states that 3,332,303 oz. of silver was produced, at a cost of 37.4c. per oz. Operating statement follows:

| | | |
|---|---|---|
| Gross settlements | | $2,628,333.01 |
| Gross value of ore and bullion at mine shipped and outstanding Dec. 31, 1920 | | 1,629,710.79 |
| | | $4,258,043.80 |
| Less: Gross value of custom ore purchased | $661,709.13 | |
| Gross value of inventory Dec. 31, 1919 | 1,093,110.95 | 1,754,820.08 |
| Gross value of 1920 ore—Nipissing production | | $2,503,223.72 |
| Cost of mining and all other expenses (including smelter deductions, treatment, etc., on settlements 1920 ore and accrued charged on ore, and bullion at mine shipped and outstanding) | $1,382,974.10 | |
| Less: Other income at Cobalt: | 136,569.28 | |
| Net cost of production | | 1,246,404.82 |
| Net income for 1920 production | | $1,256,818.90 |
| Add interest at New York, Boston, Toronto, etc | | 138,429.43 |
| | | $1,395,248.33 |
| Less: Cost and work on outside properties | $105,358.58 | |
| Loss on sale of Government bonds | 10,788.40 | 116,156.98 |
| Net profit | | $1,279,091.35 |
| Surplus, Jan. 1, 1920 | | 4,372, 52.33 |
| Less: Dividends declared and paid during 1920 | $1,235,000.00 | $5,652,043.68 |
| Dividend payable Jan. 1921 | 600,000.00 | 1,835,000.00 |
| Net surplus | | $3,817,043.6 |

The Nipissing Mines Co., a company controlling the entire stock of Nipissing Mining Co., declared dividends totaling $1,800,000 in 1920.

# MINING STOCKS

## Week Ended May 14, 1921

| Stock | Exch. | High | Low | Last | | Last Div. |
|---|---|---|---|---|---|---|
| **COPPER** | | | | | | |
| Adventure | Boston | *70 | *50 | *50 | | |
| Ahmeek | Boston | 52½ | 51 | 51 | Sept. '20, Q | $0.50 |
| Alaska-Br. Col. | N. Y. Curb | ⅛ | ⅛ | ⅛ | | |
| Allouez | Boston | 23 | 21 | 23 | Mar. '19 | 1.00 |
| Anaconda | New York | 43½ | 41⅜ | 42 | Nov. '20, Q | 1.00 |
| Arcadian Consol. | Boston | 2¾ | 2½ | 2½ | | |
| Ariz. Com'l | Boston | 9 | 8½ | 8½ | Oct. '18, | .50 |
| Big Ledge | N. Y. Curb | 1/16 | ¼ | 1/16 | | |
| Bingham Mines | Boston | 10¼ | 10 | 10¼ | Sept. '19, Q | .25 |
| Calumet & Arizona | Boston | 52¼ | 51 | 51 | Mar. '21, Q | .50 |
| Calumet & Hecla | Boston | 255 | 251½ | 253¾ | June '20, Q | 5.00 |
| Canada Copper | N. Y. Curb | .... | .... | *13 | | |
| Centennial | Boston | .... | .... | 10 | Dec. '18, SA | 1.00 |
| Cerro de Pasco | New York | 32 | 29 | 29⅜ | Mar. '21, Q | .50 |
| Chile Copper | New York | 12½ | 11⅜ | 12¼ | | |
| Chino | New York | 27½ | 25½ | 26 | Sept. '20, Q | .37½ |
| Columbus Rexal | Salt Lake | *29 | *28½ | *28½ | | |
| Con. Arizona | N. Y. Curb | .... | .... | 1/16 | Dec. '18, Q | .05 |
| Con. Copper M. | N. Y. Curb | .... | .... | 1⅛ | | |
| Copper Range | Boston | 36½ | 35 | 35 | Sept. '20, Q | .50 |
| Crystal Copper (new) | Boston Curb | *29 | *24 | *26 | | |
| Davis-Daly | Boston | 7 | 6⅛ | 6⅛ | Mar. '20, Q | .25 |
| East Butte | Boston | 9⅛ | 9⅛ | 9⅛ | Dec. '19, A | .50 |
| First National | Boston Curb | *80 | *75 | *80 | Feb. '19, SA | .15 |
| Franklin | Boston | 2¼ | 2¼ | 2¼ | | |
| Gadsden Copper | N. Y. Curb | .... | .... | *25 | | |
| Granby Consol. | New York | 24¾ | 23½ | 24⅛ | May '19, Q | 1.25 |
| Greene-Cananea | New York | 25⅛ | 23¼ | 24 | Nov. '20, Q | .50 |
| Hancock | Boston | 3 | 3 | 3 | | |
| Howe Sound | N. Y. Curb | .... | .... | 2¼ | Jan. '21, Q | .05 |
| Inspiration Consol. | New York | 37⅜ | 36 | 36⅞ | Oct. '20, Q | 1.00 |
| Iron Cap | Boston Curb | 6¼ | 6⅛ | 6⅛ | Sept. '20, K | .25 |
| Isle Royale | Boston | 22 | 20⅛ | 21 | Sept. '19, SA | .50 |
| Kennecott | New York | 22⅜ | 21½ | 22 | Dec. '20, Q | .50 |
| Keweenaw | Boston | 1⅛ | 1⅛ | 1⅛ | | |
| Lake Copper | Boston | 2⅜ | 2⅜ | 2⅜ | | |
| La Salle | Boston | 2 | 2 | 2 | | |
| Magma Chief | N. Y. Curb | .... | .... | *21 | | |
| Magma Copper | N. Y. Curb | 21½ | 21½ | 21 | Jan. '19, Q | .50 |
| Majestic | Boston Curb | *10 | *9 | *10 | | |
| Mason Valley | Boston | 1⅜ | 1⅜ | 1⅜ | | |
| Mass Consolidated | Boston | 2⅛ | 2⅛ | 2⅛ | Nov. '17, Q | 1.00 |
| Mayflower-Old Col. | Boston | 4⅛ | 4⅛ | 4⅛ | | |
| Miami Copper | New York | 23⅝ | 23⅛ | 23⅛ | May '21, Q | .50 |
| Michigan | Boston | 2⅛ | 2⅛ | 2⅛ | | |
| Mohawk | Boston | 53⅛ | 52⅜ | 53⅜ | Nov. '20, Q | 1.00 |
| Mother Lode (new) | N. Y. Curb | 5½ | 5½ | 5½ | | |
| Nevada Consol. | New York | 13⅛ | 12½ | 12½ | Sept. '20, Q | .25 |
| New Baltic | Boston Curb | .... | .... | ⅜ | | |
| New Cornelia | Boston | 16 | 15⅛ | 15⅜ | Aug. '20, K | .25 |
| Nixon Nevada | N. Y. Curb | .... | .... | *5 | | |
| North Butte | Boston | 11 | 10⅜ | 10⅜ | Oct. '18, Q | .25 |
| North Lake | Boston | .... | .... | ⅛ | | |
| Ohio Copper | N. Y. Curb | .... | .... | ⅝ | | |
| Old Dominion | Boston | 23½ | 21 | 23½ | Dec. '18, Q | 1.00 |
| Osceola | Boston | 33 | 32 | 33 | June '20, Q | .50 |
| Phelps Dodge | Open Mar. | †160 | †140 | .... | Apr. '21, Q | 1.00 |
| Quincy | Boston | 42½ | 41 | 42 | Mar. '20, Q | 1.00 |
| Ray Consolidated | New York | 15 | 14⅛ | 14⅛ | Dec. '20, Q | .25 |
| Ray Hercules | Boston Curb | .... | .... | *35 | | |
| St. Mary's Min. Ld. | Boston | 38½ | 38 | 38⅛ | June '20, K | 2.00 |
| Seneca Copper | Boston | .... | .... | 17⅛ | | |
| Shannon | Boston | 1 | 1 | 1 | Nov. '17, Q | .25 |
| Shattuck Arizona | New York | 7 | 6½ | 6⅝ | Jan. '20, Q | .25 |
| South Lake | Boston | .... | .... | 1⅜ | | |
| Superior Copper | Boston | .... | .... | 4 | Apr. '17, | 1.00 |
| Superior & Boston | Boston | 2 | 1⅜ | 2 | | |
| Tenn. C. & C. cfs. | New York | 10 | 9½ | 9¾ | May '18, I | 1.00 |
| Toulumne | Boston | *55 | *51 | *51 | May '13, | .10 |
| United Verde Ex. | Boston Curb | 29 | 26 | 26 | May '21, Q | .25 |
| Utah Consol. | Boston | 4⅛ | 3½ | 3½ | Sept. '18, | .25 |
| Utah Copper | New York | 57⅜ | 54½ | 55 | Mar. '21, Q | 1.00 |
| Utah M. & T. | Boston | 1⅛ | 1⅛ | 1⅛ | Dec. '17, | .30 |
| Victoria | Boston | *60 | *54 | *55 | | |
| Winona | Boston | .... | .... | *50 | | |
| Wo verine | Boston | 12 | 12 | 12 | | |
| **NICKEL-COPPER** | | | | | | |
| Internat. Nickel | New York | 16¾ | 15½ | 15¾ | Mar. '19, | .50 |
| Internat. Nickel, pf. | New York | .... | .... | 85 | May '21, Q | 1.50 |
| **LEAD** | | | | | | |
| National Lead | New York | 80¾ | 79 | 79 | Mar. '21, Q | 1.50 |
| National Lead, pfd. | New York | 102 | 102 | 102 | Mar. '21, Q | 1.75 |
| St. Joseph Lead | New York | 12⅞ | 12½ | 12⅝ | Mar. '21, Q | .25 |
| Stewart Mining | Boston Curb | .... | .... | *6 | Dec. '15, | .05 |
| **ZINC** | | | | | | |
| Am. Z. L. & S. | New York | 9⅛ | 9⅛ | 9⅛ | May '20, | 1.00 |
| Am. Z. L. & S. pfd. | New York | 29½ | 28½ | 29⅜ | Nov. '20, Q | 1.50 |
| Butte C. & Z. | New York | 5⅛ | 5 | 5⅛ | June '18, | .50 |
| Butte & Superior | New York | 15 | 14 | 14½ | Sept. '20, | 1.25 |
| Callahan Zn-Ld | New York | 5⅛ | 5⅛ | 5⅛ | Dec. '20, Q | .50 |
| New Jersey Zn | N. Y. Curb | 127 | 125 | 126 | May '21, Q | 2.00 |
| Success | N. Y. Curb | *3 | *2 | *3 | July '16, | .03 |
| Yellow Pine | Los Angeles | *60 | *60 | *60 | Sept. '20, Q | .03 |

| Stock | Exch. | High | Low | Last | | Last Div. |
|---|---|---|---|---|---|---|
| **GOLD** | | | | | | |
| Alaska Gold | New York | ⅞ | ⅝ | ⅝ | | |
| Alaska Juneau | New York | 1¼ | 1⅛ | 1⅛ | | |
| Carson Hill | N. Y. Curb | .... | .... | 14⅝ | | |
| Cresson Consol. G. | N. Y. Curb | 2⅜ | 1 7/16 | 2⅜ | June '20, Q | $0.10 |
| Dome Extension | Toronto | *75 | *70 | *75 | | |
| Dome Mines | New York | 21 | 18 | 19½ | Apr. '21, Q | .25 |
| Golden Cycle | Colo. Sprgs. | *74 | *73 | *73 | Dec. '20, Q | .02 |
| Goldfield Consol. | N. Y. Curb | *8 | *7 | *8 | Dec. '19, | .05 |
| Hollinger Consol. | Toronto | 7.23 | 7.20 | 7.21 | Feb. '21, M | .05 |
| Homestake Mining | New York | 61 | 57½ | 61 | Sept. '19, | .50 |
| Kirkland Lake | Toronto | *50 | *48 | *50 | | |
| Lake Shore | Toronto | 1.33 | 1.30 | 1.31 | Jan. '21, K | .02 |
| McIntyre-Porcupine | Toronto | 2.02 | 1.98 | 1.98 | Jan. '21, K | .05 |
| Porcupine Crown | Toronto | *28 | *28 | *28 | July '17, | .03 |
| Portland | Colo. Sprgs. | *62 | *62 | *62 | Oct. '20, Q | .01 |
| Reorgan. Booth | N. Y. Curb | *4 | *2½ | *3½ | May '19, | .05 |
| Silver Pick | N. Y. Curb | *6 | *3 | *5 | | |
| Teck Hughes | Toronto | *18 | *16½ | *16½ | | |
| Tom Reed | Los Angeles | *84½ | *65 | *65 | Dec. '19, | .02 |
| United Eastern | N. Y. Curb | 2⅛ | 2 1/16 | 2⅛ | Apr. '21, Q | .15 |
| Vindicator Consol. | Colo. Sprgs. | *32 | *30 | *31 | Jan. '20 Q | .01 |
| West Dome Consol. | Toronto | *10 | *8 | *8½ | | |
| White Caps Mining | N. Y. Curb | *6 | *3½ | *4 | | |
| Yukon Gold | Boston Curb | .... | .... | *70 | June '18, | .02½ |
| **SILVER** | | | | | | |
| Arizona Silver | Boston Curb | *33 | *20 | *24 | Apr. '20, M | .03 |
| Batopilas Mining | New York | 7/8 | ¾ | ¾ | Dec. '07, I | .12½ |
| Beaver Consol. | Toronto | *34 | *34 | *34 | May '20, K | .03 |
| Coniagas | Toronto | 1.76 | 1.76 | 1.76 | May '21, Q | .12½ |
| Crown Reserve | Toronto | *13 | *13 | *13 | Jan. '17, | .05 |
| Kerr Lake | Boston | 3 5/16 | 3⅜ | 3⅜ | Apr. '21, Q | .12½ |
| La Rose | Toronto | .... | .... | *23 | Apr. '18, | .02 |
| McKinley-Dar.-Sav. | Toronto | *19 | *19 | *19 | Oct. '20, Q | .03 |
| Mining Corp. Can. | Toronto | 1.12 | 0.85 | 1.09 | Sept. '20, Q | .12½ |
| Nipissing | N. Y. Curb | 4⅝ | 4½ | 4½ | Apr. '21, Q | .15 |
| Ontario Silver | New York | 6 | 5⅛ | 5⅛ | Jan. '19, Q | .50 |
| Ophir Silver | N. Y. Curb | 2 | 1⅞ | 2 | Jan. '12, | .10 |
| Peterson Lake | Toronto | .... | .... | *6½ | Jan. '17, | .01½ |
| Temiskaming | Toronto | .... | .... | *20 | Jan. '20, K | .04 |
| Trethewey | Toronto | *20 | *16½ | *16½ | Jan. '19, | .05 |
| **GOLD AND SILVER** | | | | | | |
| Atlanta | N. Y. Curb | *1 | *½ | *1 | | |
| Barnes-King | Butte | ‡.... | .... | 1.10 | Aug. '20, Q | .05 |
| Boston & Montana | N. Y. Curb | *65 | *61 | *61 | | |
| Cashboy | N. Y. Curb | *7 | *5 | *7 | | |
| El Salvador | N. Y. Curb | 3/16 | 1/16 | 1/16 | | |
| Jim Butler | N. Y. Curb | *10 | *8 | *10 | Aug. '18, SA | .07 |
| Jumbo Extension | N. Y. Curb | *10 | *6½ | *10 | June '16, | .05 |
| Louisiana Con. | N. Y. Curb | .... | .... | ⅛ | | |
| MacNamara M.& M. | N. Y. Curb | *28 | *16 | *24 | May '10, | .02½ |
| N. Y. Hond. Rosar. | Open Mar. | †10½ | †9 | .... | Jan. '21, Q | .30 |
| Tonopah-Belmont | N. Y. Curb | 1 1/16 | 1 1/16 | 1⅛ | Apr. '21, Q | .05 |
| Tonopah-Divide | N. Y. Curb | 1 1/16 | 1 1/16 | 1⅛ | | |
| Tonopah-Extension | N. Y. Curb | 1 1/16 | 1⅛ | 1 1/16 | Apr. '21, Q | .05 |
| Tonopah Mining | N. Y. Curb | 1⅛ | 1⅛ | 1 1/16 | Apr. '21, SA | .05 |
| West End Consol. | N. Y. Curb | 1 1/16 | 1 | 1 1/16 | Dec. '19, SA | .05 |
| **SILVER-LEAD** | | | | | | |
| Caledonia | N.Y. Curb | *12 | *10 | *12 | Jan. '21, M | .01 |
| Cardiff M. & M. | Salt Lake | ... | ... | *15 | Dec. '20, | .15 |
| Chief Consolidated | Boston Curb | ... | ... | 2½ | May '21, Q | .05 |
| Consol. M. & S. | Montreal | 17 | 16½ | 16⅝ | Oct. '20, Q | .62½ |
| Daly Mining | Salt Lake | ... | ... | 2.50 | July '20, Q | .10 |
| Daly-West | Boston | 3½ | 2⅜ | 3 | Dec. '20, Q | .25 |
| Eagle & Blue Bell | Boston Curb | ... | ... | 2⅛ | Apr. '21, K | .05 |
| Electric Point | Spokane | *7 | *7 | *7 | May '20, SA | .03 |
| Federal M. & S. | New York | 7⅜ | 7⅜ | 7⅜ | Jan. '09, | 1.50 |
| Federal M. & S., pfd. | New York | 27½ | 27 | 27½ | Mar. '21, Q | 1.00 |
| Florence Silver | Spokane | *15 | *15 | *15 | Apr. '19, | .01½ |
| Grand Central | Salt Lake | ... | ... | *07½ | June '20, K | .03 |
| Hecla Mining | N. Y. Curb | 4⅛ | 4 | 4⅛ | Mar. '21, Q | .15 |
| Iron Blossom | N. Y. Curb | *20 | *20 | *20 | Apr. '20, Q | .02½ |
| Judge M. & S. | Salt Lake | ... | ... | 3.00 | Sept. '20, Q | .12½ |
| Marsh Mines | N. Y. Curb | *9 | *6 | *7½ | | |
| Prince Consol. | N. Y. Curb | 1/16 | 1/16 | 1/16 | Nov. '17, | .02½ |
| Rambler-Cariboo | Spokane | *5 | *5 | *5 | Feb. '19, | .01 |
| Rex Consol. | N. Y. Curb | *12 | *10½ | *12 | | |
| South Hecla | Salt Lake | ... | ... | *65 | Sept. '19, K | .15 |
| Standard Silver-Ld. | N. Y. Curb | 3/16 | ⅛ | 1/16 | Oct. '17, | .05 |
| Tamarack-Custer | Spokane | 1.80 | 1.70 | 1.70 | Jan. '21, K | .04 |
| Tintic Standard | Salt Lake | 2.55 | 2.42½ | 2.50 | June '20, Q | .10 |
| Utah Apex | Boston | 2⅞ | 2½ | 2⅜ | Nov. '20, K | .25 |
| Wilbert Mining | N. Y. Curb | *4 | *2½ | *3 | Nov. '17, | .01 |
| **QUICKSILVER** | | | | | | |
| New Idria | Boston | .... | .... | *50 | Jan. '19, | .25 |
| **VANADIUM** | | | | | | |
| Vanadium Corp. | New York | 38 | 33½ | 34 | Jan. '21, Q | 1.00 |
| **ASBESTOS** | | | | | | |
| Asbestos Corp. | Montreal | 64 | 61 | 61 | Apr. '21, Q | 1.50 |
| Asbestos Corp., pfd. | Montreal | 83 | 82 | 83 | Apr. '21, Q | 1.75 |
| **MINING, SMELTING AND REFINING** | | | | | | |
| Amer. Sm. & Ref. | New York | 44¾ | 41½ | 42 | Mar. '21, Q | 1.00 |
| Amer. Sm. & Ref. pf. | New York | 80 | 77⅞ | 77⅞ | Mar. '21, Q | 1.75 |
| Am. Sm. pf. A | New York | 71½ | 71½ | 71½ | Apr. '21, Q | 1.50 |
| U. S. Sm. R. & M. | New York | 34½ | 33½ | 34 | Jan. '21, Q | .50 |
| U.S.Sm.R.& M. pf. | Boston | 42 | 40½ | 41 | Apr. '21, Q | .87½ |

* Cents per share. † Bid or asked. ‡ Quotations missing. Q, Quarterly. SA, Semi-annually. BM, Bi-monthly. K, Irregular. I, Initial. X, Includes extra.